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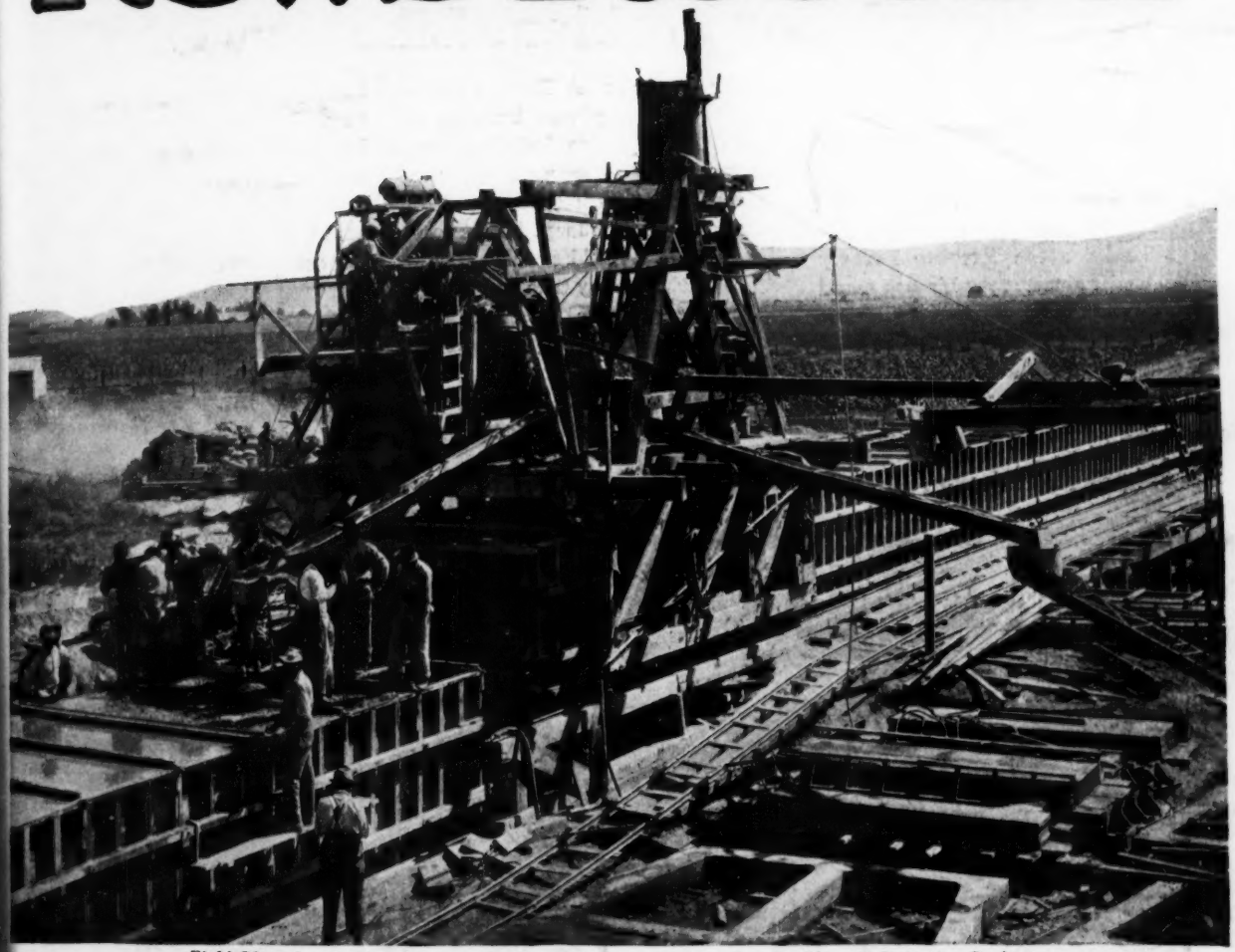
February 1, 1923

Engineering News-Record



Field Plant for Casting Concrete Trestle and Flume Sections for the Klamath Irrigation Project

Precast Concrete Flume on the Klamath Irrigation Project

By E. C. Knappen

A Review of the Grand Trunk Railway Arbitration

By J. P. Newell

Beginning: Series of Impressions on British Sewage Treatment

By George W. Fuller

Foundation and Scour Protection at Power House on Mississippi River

Report of the Annual Meeting of the American Concrete Institute

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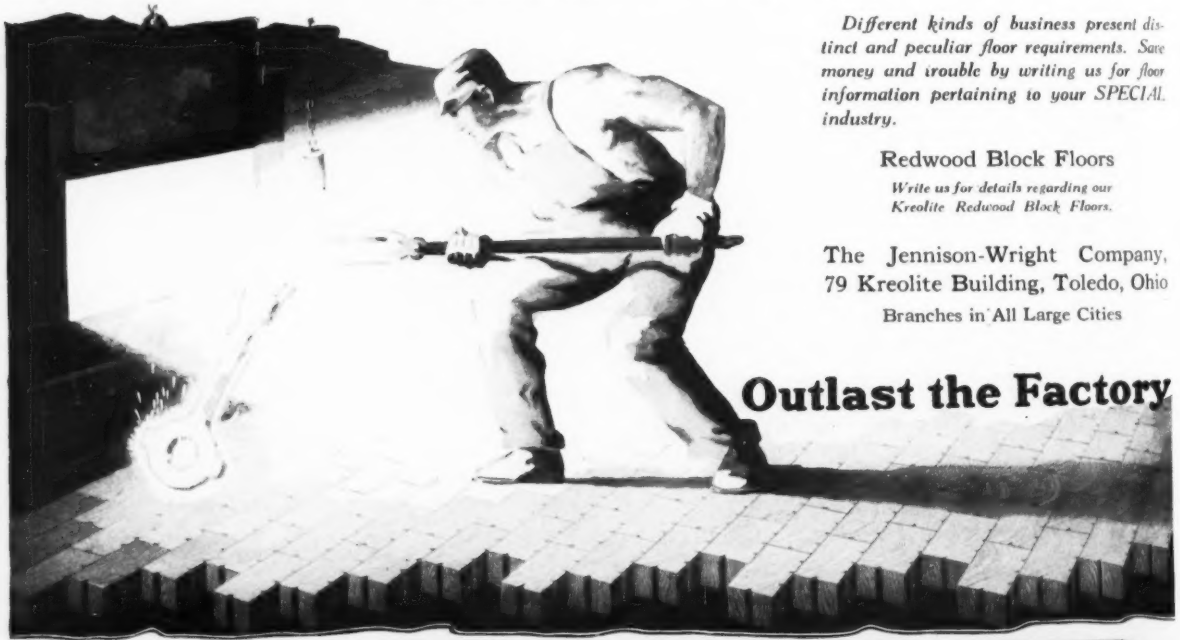

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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN
Editor

Volume 90 — NEW YORK, FEBRUARY 1, 1923 — Number 5

Status of British Sewage-Works

PILGRIMAGES to British sewage-works have been undertaken by American engineers with profit to themselves, the profession generally and their municipal clients for many decades past. The latest of these was made last month by George W. Fuller—by no means his first, it will be understood. With no loss of time on Mr. Fuller's part or that of *Engineering News-Record* our readers are to have the benefit of Mr. Fuller's well digested conclusions on "The Present Status of Sewage-Works in England." The present installment, which deals with questions of administration and policy, will be of value to all who are giving careful thought to a number of questions in the fields of municipal economics and central government control. The second article, on older methods of treatment, will contain many observations and conclusions bearing upon American problems. The third article, on the activated-sludge process in England, will be eagerly read in view of the growing American interest in what for years past has been one of the most interesting, and promising, but in some of its details the most baffling, process of sewage treatment that has ever been brought to the front.

Noted Without Enthusiasm

AGREEMENT between the operators and the United Mine Workers to continue the existing wage scales and working conditions for another year represent simply an extension of the truce declared last year after the victory of the miners. By it we are assured peace and a continued supply of fuel until the President's commission can complete its study and perhaps suggest some plan of readjustment for the industry whereby the consumer may be freed from the present burden of excessive costs. The consumer knows, of course, that until this has been done he must continue to submit to this burden as an alternative to a fuel famine, so the announcement of the agreement has been received without enthusiasm.

Labor in Banking

NO NEW departure is heralded in the news that the Brotherhood of Locomotive Engineers is to open a new bank in New York and that it has bought an interest in the Empire Trust Co. in that city. For nearly three years organized labor has used its resources in this fashion to the benefit both of labor and of the community, and today labor banks are in operation in several industries and in several cities. These further developments, however, have suggested a variety of comment, some of which appears to be puerile, but some of which appeals to us mightily. It is gratifying, for example, to reflect upon the opportunity here offered for employers and employees to get their feet under the same table in order to consider economic problems from the same viewpoint. Frequently heretofore they have met to adjust conflicts of interest. Out of such meetings has grown a measure of mutual understanding and respect that has been good for both; but not by that process alone can there be developed that sense of community of interest and of purpose that becomes more and more essential to the working out of our industrial destiny. Is it too optimistic to hope that the extension of this new relationship will help toward strengthening in both parties convictions as to their common interests that will be reflected in the conduct even of those matters in which there may be temporary and superficial conflict?

Three Hundred City Managers

THE growing favor of the city manager plan is shown by the fact that last year alone it was adopted by 74 municipalities, compared with 52 in 1921 and 36 in 1920. Altogether the plan has been adopted by 304 cities, according to the *City Manager Magazine* (Lawrence, Kan.) for January. Since the city manager plan is based on the sound principle of separating legislative from executive functions and making one man responsible for the latter, and since experience shows that the plan makes for increased municipal efficiency and economy, its rapid progress is encouraging. The city manager plan has a direct appeal to engineers for the reason just stated and also because a large percentage of the managers are engineers and because whether engineers or not the engineering and other technical staffs of a city under the manager plan obtain a larger measure of just recognition than under the older plans of municipal government.

City Managers in New Jersey

WHEN it is considered that the city manager plan is the natural and frequent outgrowth of the commission plan and that New Jersey has a large number of commission governed cities, it seems strange enough that year after year the legislature of that state balks at proposed legislation which would do no more than permit the voters of the municipalities of that state to vote for or against having a manager. New York on the east and north and Pennsylvania on the west have many manager cities and the manager plan has been adopted in two-thirds of the states of the Union, Michigan leading with 33 adoptions, California following close after with 29, Virginia and Texas having 23 each and Florida 22. The only explanation of the repeated defeat of a city manager enabling act in New Jersey that we have seen or heard, aside from the well known opposition to reform measures on the part of politicians, is that the commissioners in the commission plan cities are opposed to a change that would rob them of all their executive powers and their corresponding titles as administrative department heads and cut down their salaries as well. In most of the New Jersey communities or of those of any other state under the commission as contrasted with the commission-manager plan, the personal losses to a few commissioners would be a

great gain to the whole body of citizens and taxpayers, through substituting trained for untrained administrative heads of departments and paying salaries accordingly.

Precast Concrete Flumes

FLUME design and construction in the irrigated country of the West seem ever to be in a state of flux, so far as type is concerned. One of the latest developments noted elsewhere in this issue is the utilization of short precast units of flume cast in an inverted position in a continuous line paralleling the final position. Joints similar to those used in concrete pipe expedite the erection, taking up easily the irregularities of the unit-built trestle members on which the flume rests. This type of precasting a whole section is a step in advance of the work done on the King Hill Project by Reclamation Service engineers (See *Engineering News-Record* Dec. 8 and 22, 1921, pp. 926 and 1014) where the bottoms were cast monolithic after the precast sides had been set up. The cases are not quite comparable because the Klamath flume is on trestle while the King Hill sections all rest directly on the earth. Furthermore, the restricted space for work on the steep side hill of the latter location would have precluded the decided advantage of stringing out a casting yard parallel to the existing flume. Transportation equipment heavy enough to carry in the full sections over the flume subgrade probably could have been installed at King Hill but it would have been decidedly cumbersome in such cramped quarters. The tightness feature in the Klamath work is not at all surprising considering the ease with which pipe under pressure made with similar joints has exceeded the rigid guarantees at Denver, Kansas City and Norfolk.

Hoping Against Hope

HOPEFULLY, but with misgivings, the American people have been watching developments in the Ruhr. There can be no doubt as to where their sympathies lie. There can be no doubt as to their conviction that Germany should be made to expiate the crime of 1914 and to pay the price by which she bought off an allied advance to Berlin in 1918. Nevertheless, there persists a disturbing doubt as to whether the present course is likely to achieve even those limited ends. Although it would be risky to estimate the eventual prospects of French policy solely in the light of the set-back it necessarily has incurred at its beginning, many are wondering uncomfortably whether a great moral advantage may not have been surrendered for the sake of an ephemeral and insignificant triumph. And few will contend that the events of the last two weeks have contributed towards a solution of the overshadowing problems that beset humanity. Far and away beyond the material chastisement of the Germans, a distracted world demands the restoration of industrial and political relations that will cool the wasting fires of class and race hatred, stimulate the productive instincts and re-awaken in humankind the almost-forgotten habits of individual ambition and thrift. The misgivings that oppress those who feel affectionately and sympathetically toward the French people may rise from an intuition that the present measures, however sorely provoked and however resultful in material returns, are out of harmony with the more essential and more universal requirements.

Some Doubts About Concrete

IN ANY science or philosophy an honest skepticism is the beginning of progress. Too easy and general acceptance of theories and practices results in marking time and then retrogression. Engineering, being a live and progressive science, is full of skepticisms; if it were not, technical societies would soon perish of inanition, for the mere reading of descriptions of work done would lose its interest unless flavored with the salt of controversy over what theories and facts should be accepted. Last week at Cincinnati the proceedings of the American Concrete Institute revealed many skeptics, so far as the science of concrete is concerned. Never before, it seemed, in the nineteen years of that society, were there brought out so many doubts as to theory and practice or so many questions which could not be answered satisfactorily. This merely reflects, we believe, the general situation in the field of concrete and is a healthy rather than a morbid indication.

Some of these doubts and questions are worth setting down here, not in the hope of getting or giving answers but to mark wherein future study lies and to discount, perhaps, a certain smugness of attitude that concrete practitioners are apt to affect. There are so many things on which there is disagreement that it ill becomes any one to claim complete knowledge.

First, there is a very general concern over the behavior of outdoor concrete. For some years this has been a matter of individual expression, of secret whisperings glossed over in open discussion and explained on the easy ground of improper materials and manufacture. More and more bad concrete is being brought to light, however, and the policy of suppression of facts—though policy and suppression may be too strong words—is retreating before a demand that the cards be thrown on the table and that the committees of the proper engineering societies frankly admit that there are all too many examples of five to fifteen year old concrete, placed by competent contractors and engineers, which are far from permanent and which if examined and classified might reasonably yield some information that would help in future structures. The more recently expressed principles of good concreting have been based on widely published tests tempered with the information gained from too frequently suppressed failures. When the failures have as much publicity as the tests the reasons for the principles laid down will be better appreciated, especially by those who consider tests somewhat impractical and who demand proof from the actual structure.

In the same category comes the well-worn subject of sea water concrete. For years this has been the plaything of the theoreticians, but except for one minor and over emphasized set of tests and one extensive tour of field examination made by two men we have progressed little beyond the theories of cement chemists of two decades ago. Concrete goes to pieces in sea water more frequently than not, but the fact that sometimes it does not points to need of a study comprehensive in scope and particularized in examination. The doubts that exist are not going to be exorcised by the questionnaire method.

Doubt as to the value of tests because of variations in test results were made much of at the Cincinnati meeting. This, however, is a fault being cured with time. As the materials that go to make up concrete are being improved and as the methods by which tests

are being made become standardized the tendency for uniformity of test results increases and the relation between test and performance tends to become closer. The present doubts are held by those who expect more from tests than tests can ever give. The man whose business it is to make them has more respect for their potentialities of variation than the man who only uses them.

In concrete construction several questions are not definitely answered. One is the matter of integral waterproofing—complicated by commercial considerations and the peculiarities of contractor psychology—and another the desirability of chuting—in which also the matter of dollars and cents is so large a factor. It is common among those who may be properly called the "concrete intelligentsia" to decry integral waterproofing, to claim on the basis of many tests that nothing is added by the use of such materials that can not be just as cheaply and effectively achieved by the proper procedure of normal concreting—and yet integral waterproofing continues to be made and used in large quantities. Must pragmatism retreat before pure reason or shall we have a final orderly theoretical and empirical examination of the question which will settle it or at least arrive at a fair compromise? In chuting, on the other hand, theorizing has no place. It is a matter of examination of each job and a balancing of opinion, which in the end must be individual, as to the quality of concrete that can be produced by this method. The unsuccessful attempt at Cincinnati to get some registration of opinion one way or the other on the chute problem shows why there are doubts on this question.

Skepticism as to rational methods of proportioning is far less than it once was; there are signs that we are approaching some sort of solution. For years a number of different investigators have been striking out into new fields of investigation, all directed to the same end of finding the optimum mix and most of them along different paths. These paths seem to be nearing convergence and a single way partaking somewhat of all the approaches may soon be reached. The problem now is to popularize the methods which necessarily in the making became a little cumbrous and which need simplifying and broadcasting so as to reach the man at the mixer or at least the man who bosses the man at the mixer. Doubts here are no where near as great as they were five years ago.

These are the more important of the debatable phases of concrete. They indicate that in spite of the fact that the country is dotted with well made, durable concrete structures the practice of producing such structures is by no means reduced to a formula, easily stated and easily learned. Foreman, superintendent or contractor can make or mar a job for which designer and material manufacturer have furnished the best the art affords—and vice-versa. There must be a wider distribution of the knowledge we already have so that each factor in the production of concrete is equally well informed and there must be more intensive and distributed study so that that knowledge is increased.

Within a certain limited group, a group represented fairly well by the American Concrete Institute and a part of the American Society for Testing Materials, there is going on an intense study of concrete but there are times when such doubts and questions as are noted here lead one to believe that the men of this group unintentionally form a very close corporation outside of which is the vast body of concrete users, picking up such crumbs as fall from the table but placing concrete in the main just as it was placed a decade ago. Both within and without that group there are skeptics, those within because they know so much, those without because they know so little. That their collective doubts may be resolved by more and wider study may sound paradoxical but it is offered as a fact. Contrary to a view once widely held, concrete is an intricate material. We are only just beginning to learn how to make it and how it behaves when made. No effort should be spared to increase our knowledge.

As to Student Activities

ALTHOUGH the discussion on engineering education at the annual meeting of the American Society of Civil Engineers produced little that could be considered as helpful in the practice of teaching, there was some stimulating talk with regard to the extra-curricular interests and activities of the undergraduate. John L. Harrington, president of the American Society of Mechanical Engineers, was most explicit perhaps, in his contention that the student sections of the national engineering societies are failing in their purpose and that they should be replaced by a self-governing undergraduate engineering society of general rather than specialized scope.

Faculty guidance and supervision should always be available for undergraduate activities, but it is axiomatic that if those activities are to be of the greatest value to the student they should be in the highest possible degree "self-starting." Student sections that are kept active mainly through the efforts of faculty members are of questionable value either to the students or to the parent societies. Whatever may be the merits of the substitute suggested by Mr. Harrington, his criticism of the student sections as at present constituted and conducted deserves the consideration of the national societies of which they are a part.

All this has implications beyond the question of student chapters for we are inclined to wonder whether we do not often fret ourselves unduly over the mental attitude of the undergraduate toward his work and his career. As Dean Ketchum put it, we are sometimes in danger of "losing our heads in our desire to make a man out of a boy." To insure a thorough and systematic covering of the prescribed courses of study it is essential, of course, that the faculty exercise a complete and unquestioned control of curricular work; but when it comes to the outside activities of the student body, intellectual as well as physical, the wise faculty remembers that after all, most engineering undergraduates are youngsters still with many interests and enthusiasms aside from the serious business of their intellectual training. In this respect, indeed, they are little superior to their elders, who have contrived all sorts of devices whereby they may now and then get away from "shop" and forget the serious business of life.

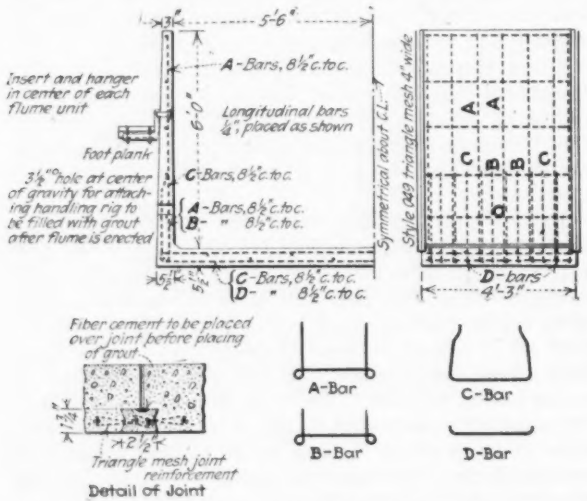
And so long as these activities are so restricted and supervised as not to interfere with the essential business of the institution we are inclined to think that the undergraduate will derive from them a benefit that will be directly proportional to their "self-starting" qualities. Student activities should live just so long as they are kept alive by student interest, without recourse to a faculty pulmotor.

Precast Concrete Flume on Klamath Project

Of Six Comparative Designs Precast Type Chosen at Lowest Capitalized Cost—Short Flume Sections Constructed Along Old Flume with Traveling Concrete Equipment

By E. C. Koppen
Engineer, U. S. Reclamation Service, Klamath Falls, Ore.

FORCES of the U. S. Reclamation Service on the Klamath Project have recently completed between two irrigation seasons the construction of a precast concrete flume in an inverted position in a continuous line of sections parallel to the 13-year-old timber structure replaced. After removal of the existing flume the sections were turned over and set on precast bents and stringers. Low capitalized cost was the controlling factor in determining the use of the precast type. A combined mixer-and-derrick traveler straddled the


5'-6"
A-Bars, 8½" c. to c.
Insert and hanger in center of each flume unit
Longitudinal bars ¼" placed as shown
6'-0"
Foot plank
C-Bars, 8½" c. to c.
3½" hole at center of gravity for attaching handling rig to be filled with grout after flume is erected
A-Bars, 8½" c. to c.
B- " 8½" c. to c.
C-Bars, 8½" c. to c.
D- " 8½" c. to c.
Style 249 triangle mesh 4" wide
Symmetrical about C.L.
D-bars
4'-3"
Fiber cement to be placed over joint before placing of grout
Triangle mesh joint reinforcement
Detail of Joint
A-Bar
B-Bar
C-Bar
D-Bar

STANDARD PRECAST FLUME UNIT

forms for the precast flume sections and delivered concrete by chute to the forms for the trestle members alongside the positions they were finally to occupy. The new flume, including inlet and outlet transitions, is 4,316 ft. in length and has a capacity of 335 sec.-ft.; at the lower end the flume connects with a concrete-lined canal 7,600 ft. in length.

The precast work of 2,600 cu.yd. consists of 990 flume sections; 335 sets of stringers, 3 stringers to a set; 55 solid bents from 1 to 5 ft. in height; 268 framed bents from 5½ ft. to 11½ ft. in height and 14 framed bents from 15 to 15½ ft. in height; the latter are braced diagonally. The flume units are 11 ft. wide, 6 ft. high and 4 ft. 3 in. in length.

The precast work was begun on April 27 and completed on Aug. 13, 1921. Water was turned out of the canal on Sept. 15 and dismantling the old timber flume was begun on Sept. 20. Erection of the new flume was begun on Sept. 29 and was completed on Jan. 10, 1922.

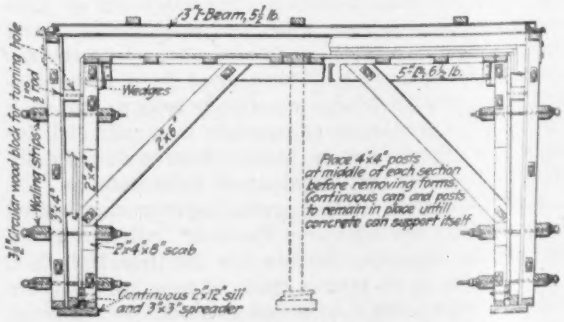
On May 10, 1922, water to a depth of 4 in. was turned into the new flume; and the depth was gradually increased with the demands for irrigation until at the end of the month the water in the flume was 4 ft. deep. Throughout the length of the flume only a small amount of leakage developed. At several points a small stream about ⅛ in. in diameter appeared and a large number of sweat spots, usually near the lower part of the side of the flume, developed. At some of the sweat spots sufficient leakage occurred to cause occasional dripping; generally however, the leakage was only sufficient to show moisture on the outside of the flume. Practically all of the sweat spots dried up in a few days and most of the larger leaks within 30 days.

Selection of Type—The replacement of the old timber flume was considered during 1919 and again in 1920, but due to abnormal conditions following the war actual construction was deferred until 1921. Comparative designs and estimates were prepared for three types of flume construction and for three types of pressure pipe as follows:

Flume semi-circular, metal.
Flume semi-circular, wood.
Flume precast concrete.
Pressure pipe, concrete, monolithic.
Pressure pipe, lockjoint precast concrete with cradle.
Pressure pipe, lockjoint precast concrete without cradle.

The new structure was to be built without interfering with the old flume during the irrigation season of 1921, and was to be ready for service prior to the irrigation season of 1922. The design for the precast siphons contemplated the construction of the pipe during the irrigation season. The pipe was to be laid in a trench 6 ft. deep either on line with the timber flume or at an offset from it. For the monolithic siphon it was contemplated that it would be constructed during the irrigation season and at an offset from the timber flume. The several designs provided for building the new flume on the same line as the old flume. For the metal and wood stave types a new foundation was to be constructed consisting of masonry piers or pedestals, two to a bent, the bents to be at intervals of 16 ft. The masonry piers were to be constructed during the irrigation season and the flume to be erected immediately following the irrigation season. For the precast type of flume, the design contemplated using the old foundation, which consisted of three masonry piers to each bent, with the bents at 12-ft. centers. The precast type also contemplated the construction of the precast units during the irrigation season and the erection of the precast units immediately following.

An estimate was made of the cost and also of the probable life of the various types of construction, also


3" I-Beam, 5½ lb.
5" I-B, 6½ lb.
Wedges
2"x6"
2"x4"
Place 4"x4" posts at middle of each section before removing forms. Continuous cap and posts to remain in place until concrete can support itself
2"x4"x8" scab
Continuous 2"x12" sill and 3"x3" spreader

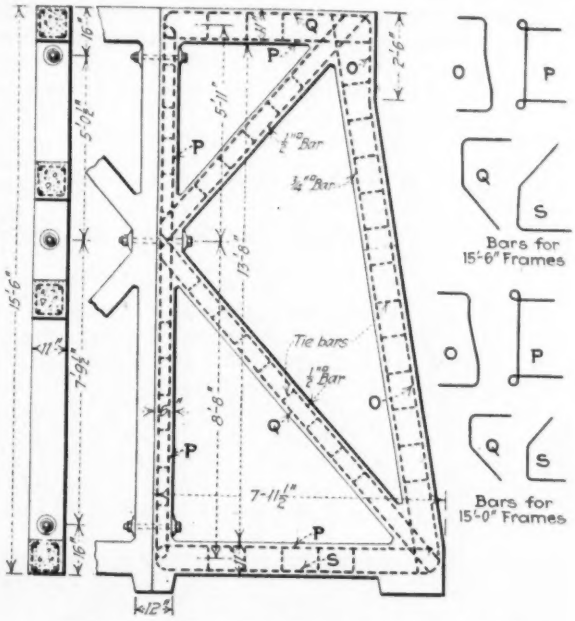
CROSS-SECTION OF FLUME FORMS ASSEMBLED

of the annual cost to maintain the structure in perpetuity. To make the estimated costs of the several types of construction directly comparable the annual cost to maintain the structure in perpetuity was capitalized, using a basis of 6 per cent.

The precast concrete type of flume was finally adopted, the decision being based almost wholly on the capitalized cost. The advantage over the metal and wood flumes is probably much greater than shown by the capitalized cost. It is doubtful if either the metal or wood flumes would have a dependable life of twenty years. On the other hand, there is every reason to believe that the precast concrete flume with reasonable care will have a longer life than estimated.

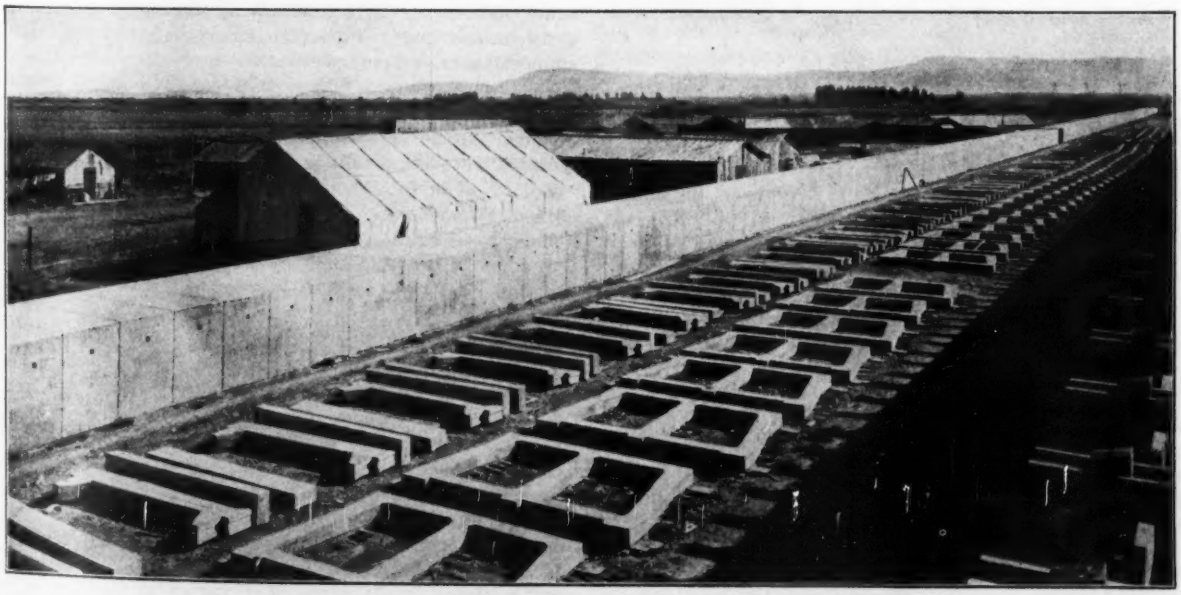
Construction Planning—As a preliminary to the design of forms and the plant layout, a study was made of construction methods. Concreting was to begin about May 1, the number of forms and the plant layout were to be such that the precast work would be completed during the latter part of August. The flume sections were to be cast continuous and to be left in place until they were to be erected. Use was to be made of a simple and economical joint and end form which could be left in place. The interior flume section forms were to be constructed and braced in such a manner as to permit the use of portable track and small flat top cars for moving the forms ahead. The concreting machinery was to be mounted on a traveler and the concrete mixer to be set at a sufficient height to permit of chuting the concrete directly to the forms. The steel units for the stringers and flume sections were to be tied ahead of the forms. The work of dismantling of the old timber flume and the erection of the new flume was to be treated as one job.

Form Requirements—Accurate formwork and casting of all precast units were of the utmost importance to insure close fitting in the completed structure. Of almost equal importance was the matter of securing forms that would fit in with the general construction plan. The requirement was for simple forms that could be easily and quickly moved and assembled. For the flume sections it was deemed essential that the method of interior bracing be such as would permit the use of portable track and low flat cars for moving the forms ahead. The forms used gave excellent service and required but few measurements in assembling.



PRECAST BENT FRAME FOR 15 FT. 6 IN. UNIT

Flume Sections—The outer and inner forms were 8 ft. 7½ in. long and corresponded in length to two flume sections. Twenty-four sets of inner and eighteen sets of outer forms were provided. The forms were used from twenty to thirty times and were still in good shape when the job was completed. For each setting the forms were thoroughly scraped and sprayed with oil.



FLUME AND BENT CASTING YARD ALONG OLD WOOD FLUME

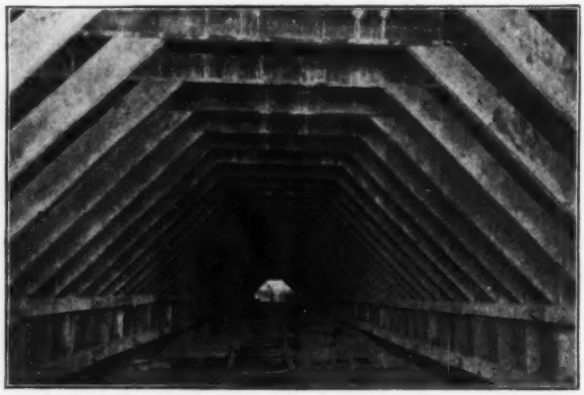
The flume sections were cast continuous and a part of the joint form and the separator were left in place until erection. Holes for turning the flume sections were cast at the center of gravity of each section. Concrete footings to fit the old pedestals were cast on the bottom of the bent sills.

TABLE I—REPLACEMENT OF "C" CANAL FLUME—COMPARATIVE COSTS FOR DIFFERENT TYPES OF CONSTRUCTION

	Flumes			Siphons		
	Semi-circular				Precast Lockjoint Pipe	
	Galvanized Metal	Wood	Precast Concrete	Monolithic	With Concrete Cradle	Without Cradle
Assumed total life of structure	20	20	50	50	50	50
Estimated total construction cost, overhead and contingencies not included	$129,440	$109,300	$134,892	$190,460	$171,520	$175,220
Yearly interest on first cost at 6 per cent	7,766	6,558	8,093	11,428	10,291	10,513
Annuity required to replace at end of estimated life at 6 per cent compound interest	3,518	2,971	464	655	590	603
Annual allowance for maintenance and repairs	1,000	800	400	200	200	200
Total annual cost of structure	12,284	10,329	8,957	12,283	11,081	11,316
Present capitalized cost to maintain in perpetuity at 6 per cent	204,700	172,100	149,300	204,700	184,700	188,600

Note: The estimated costs do not include the intake, outlet or other special structures.

The studding for the forms was placed at intervals of 18 in. with 2 x 4-in. material used for the inner forms and 3 x 4-in. for the outer. For the top forms the studding was placed flat. The lagging consisted of 1-in. surfaced material and was covered with No. 26 gage black sheet metal. The roof beams consisted of 5-in. 6.5-lb. structural steel channels. They were spaced the same as the studding and were bolted to the inner forms. The forms and roof beams were held in position by corner braces, two to each roof beam. The roof forms were made in two parts, leaving an 8-in. gap at the center which was closed by a strip of sheet metal and a 3 x 4-in. timber cap. Bolt holes in the braces, studding and roof beams were carefully bored to permit interchanging the various parts. All bolt holes in the studding and braces were protected by strap washers nailed in position. Square-headed bolts ⅜ in. in diameter with winged nuts were used throughout.



UNRESTRICTED SPACE IN INTERIOR OF FORMS

The interior flume section forms were constructed to permit the use of track and small flat cars for moving the forms ahead. The side wall forms were held together by three tie rods passing through the forms and waling strips at each joint. The roof beams consisted of 5-in., 6.5-lb, structural steel channels. When this picture was taken the forms had been used fifteen times.

For setting the flume section forms continuous 2 x 12-in. sills and 3 x 3-in. separators were placed first, usually several hundred feet in advance of the forms. The sills and separators were placed on previously established line and grade, the latter being approximately the natural slope of the ground. The 3 x 3-in. separators were set with a gage and spiked to the sills, the distance between the separators corresponding to the width of the flume.

The inner forms were placed first, the bottom of the wall form being set on the 2 x 12-in. sills and against the 3 x 3-in. separator. The forms were then wedged up to the desired height. The previously tied units of reinforcement, the joint forms and the form for the 3-in. hole at the center of gravity of the section, for turning, were placed next. The outer forms, waling strips and top ties were then placed in position and the forms drawn tightly against the joint forms. The reinforcing steel was suspended from 2 x 4-in. stringers placed over the top ties.

Three sets of waling strips and a tie across the top were used to hold the inner and outer forms together; for interior bracing two corner braces were used for each roof beam. The side wall forms were held together by three tie rods passing through the forms and waling strips at each joint. The tie rods were made of ½-in. square and round iron with a loop and shoulder at one end, the round part being only long enough to permit the necessary threading. The holes for the rods marked the ends of the flume units; the tie rods passed through the slots in the joint forms and came in contact with the end separator, thus preventing the bending or buckling of the joint form while concreting. The top ties consisted of 3-in. I-beams, adjustable at one end. Holes, ½-in. in diameter, were bored in the flanges of the I-beams at intervals of 18 in. The top ties were placed directly over the top joint form, and the vertical member of the joint form was prevented from tipping by nailing through the small holes in the I-beam.

The outer forms were usually removed in two days and the inner forms in three days after concreting. The outer forms were tipped out and loaded directly on small flat cars. Before removing the inner forms, a 4 x 4-in. post was set directly under the continuous cap, supporting each flume section at the center. The inner forms were then removed, the parts being carried beyond the posts and loaded on flat cars. The posts and continuous caps supporting the roof of the flume sections were removed about fifteen days after pouring.

Joints—The joint forms were built of specially machined material, the pieces forming the joint being hollowed out to take the wire mesh. The inner part of the form was reclaimed in about fifteen days, the remainder of the form being left in place until the units were erected. Slots were made in the pieces forming the joint to permit the tie rods to come in contact with the end separator; this prevented the joint forms from bending while the concrete was being poured.

Bents—The solid and framed bents were built to fit the elevations of the old pedestals. For the framed bents standard heights varying by intervals of 6 in. were adopted. The standardization of the bent heights greatly simplified the forms and the work of bending and placing the reinforcing steel. The tops of the old pedestals varied in elevation by odd amounts; frequently those in the same bent varied in elevation by an inch or more. The difference between the standard bent height and the height required to fit the pedestals

was made up by casting three concrete footings, varying from 2 to 6 in. in height, on the bottom of the bent sill. By building the bents to fit the height of the old pedestals, shimming during erection was reduced to a minimum. This arrangement was in accordance with the general plan of dismantling the old flume and erecting the new flume at the same time, using only one hoisting rig.

The Casting Yard—The casting yard occupied a strip of ground 100 ft. wide, parallel to and adjacent to the old flume. The old flume leaked badly and considerable work was necessary to properly drain, fill in and level the casting yard. For a distance of 3,000 ft. the waste dumps of conveniently located drainage ditches were used to fill in the casting yard. The drainage of the yard was accomplished by digging a small ditch parallel to the old flume and close to the pedestals.

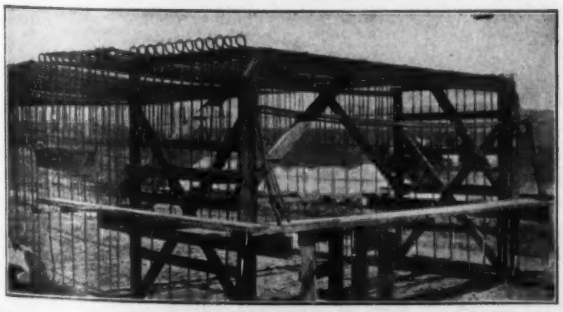
A slough 150 ft. wide and the diversion canal were crossed on pile trestles. Due to leakage and spray from the old flume, no casting was done within 12 ft. of the nearest pedestal. During unfavorable winds the spray was kept away from the work by canvas curtains temporarily nailed to the old flume.

Reinforcing Steel—The thickness and shape of the precast units was such as to require the accurate bending and placing of all reinforcement. The work of bending was remarkably well done, the various bars fitting into place almost perfectly. The reinforcing steel was cut to length before shipment. The benders and other tools were made on the job.

For the flume units the reinforcing steel was bent on a table into which pins were bolted at the required intervals. For the looped bars, short pieces of pipe of the required diameter were placed over the pins. Ordinary right and left-hand hooks were used for making the bends. As gages were set for each bend, no measurements were made after the gages had been set, except to check the overall length of the bars. Two men working together averaged about 500 of the *A* and *B* bars per day. For the *C* bars two men bent about 300 per day, only one man bending at a time. For the *D* bars one man bent about 250 bars per day.

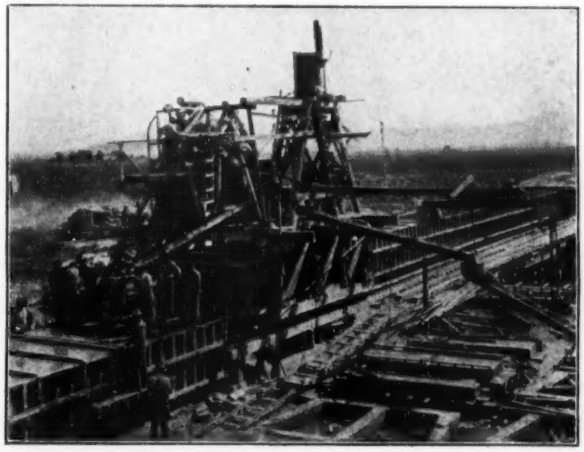
The hooks and other bands for the stringer steel and also for the bent steel were bent on an ordinary bench bender, a pipe vice being used for holding the bars where no creep could be permitted. The looped bars for the framed bents were bent around the hub of a wheel, the diameter of the hub being varied as required. On the wheel bender the wheel revolved on a vertical axle. With this rig three men bent 200 of the double looped bars per day.

The steel units for the flume sections and for the stringer units were prepared well ahead of the concreting and were lifted into position as the forms were placed. The steel units for the flume sections were tied on a collapsible frame directly on the sills ahead of the forms. Four men tied about twenty complete units per day. For the framed bents the reinforcing steel and hoops were tied directly over the forms and when completed were lowered into position. The use of patented tie wires and tying tools greatly expedited the work of preparing the reinforcement units.



REINFORCEMENT UNITS SET UP ON COLLAPSIBLE FRAME

When the forms were set up the reinforcement units were lifted into position.



TRAVELING CONCRETE EQUIPMENT POURING SECTION

The concreting equipment was mounted on a traveler which straddled the flume section forms. The traveler was rigged with an A-frame and booms and chutes for chuting the concrete directly to the flume forms at the back or to the stringers and bent forms at the side.

Concrete Plant—The plant consists of a traveling platform on which were mounted the 10-cu.ft. concrete mixer, water tank and a 6-hp. reversible gasoline hoist for moving ahead. The traveler straddled the flume section forms and was rigged with an A-frame and booms and chutes.

A material supply track for charging the mixer was laid parallel to the line of the flume. Sand and crushed rock were delivered in piles placed at intervals of about 50 ft. The concrete materials were shoveled into small cars and dumped into the charging skip. Water for mixing was pumped from the old flume. Cement was hauled from the storehouse.

Materials—Sand shipped in from Marysville, Calif., about 400 miles, was of medium coarse uniform grains, the particles consisting of a hard siliceous material, well graded as to size. The crushed rock was procured from a local quarry, 12 miles away, and was furnished in two sizes, No. 1 passing a screen of ¾-in. mesh and No. 2 passing a 1½-in. mesh and held on a ¾-in. mesh. The rock used is a hard tight-grained black syenite. The cement and sand were delivered on cars, 4 miles from the job. The hauling was done by motor truck, under contract. Transportation of sand cost $2.25 per cubic yard including loading. Other freight cost from 32 to 35c. per ton-mile for hauling. The crushed rock was delivered on the job by motor truck by a local contractor.

Mixing—Concrete proportions were one part cement, hydrated lime, 10 per cent by weight of cement, one and one-half parts of sand and three parts of crushed rock, consisting of about 30 per cent of No. 1 and 10 per cent of No. 2. The minimum amount of water was used in mixing and each batch was kept in the mixer about

LIFTING THE FLUME SECTIONS INTO PLACE

two and one-half minutes before dumping. The mixed concrete was always of a jelly-like consistency and flowed slowly down the chutes, which were set at an angle of about one vertical to three horizontal.

Placing—In pouring the flume sections, considerable care was necessary, particularly with the thin side walls. The main considerations were to secure maximum density and to avoid cracks, particularly at the intersection of the floor and side walls, and also to secure a smooth surface at the inner and outer faces. The concrete in the side walls was brought up in 1-ft. lifts on several sections to give ample time for working the concrete.

The concreting layout and the number of forms were planned for a monthly progress of 1,200 ft. Usually from 40 to 60 ft. of completed flume were poured each day, but the high run during the job was 105 ft. of completed flume.

The bottoms of the flume sections were screeded to true lines by means of a 3-in. beam, worked across the tops of the outer wall forms. The flume sections were then finished with a steel trowel but the bents and stringers were rough finished. All corners of the precast units were rounded.

Curing—The flume section forms were removed in two or three days, but the side forms for the bents and stringers were usually removed in one day after pouring. The bents and stringers were kept moist by spraying for a period of ten days.

For the flume sections the top was covered with burlap immediately after finishing and the sides after removing the outer forms. The burlap was used in strips about 7 ft. wide and 100 ft. long and left in place for about 10 days. It was kept saturated by two lines of 1-in. perforated pipe laid along the top of the flume sections.

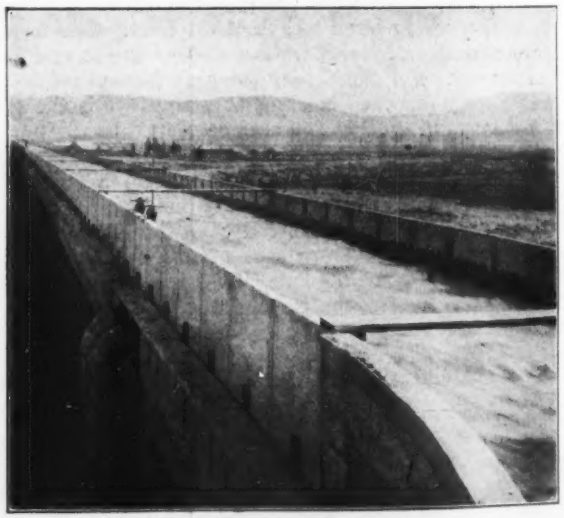
For the inside of the flume sections the air was kept moist at an even temperature for 10 days by steaming during the night, the steam being supplied from a 30-hp. boiler mounted on trucks. A low-pressure wet steam was used, the object being to create a dense fog containing a maximum amount of moisture at a low temperature. The steaming process was usually confined to a length of 300 ft. Canvas curtains used at the ends of the section being steamed, were shifted daily.

Dismantling and Erecting—The work of dismantling the old timber flume and of erecting the new precast concrete flume, which was treated as one job, progressed at the rate of about 65 ft. per day. The crew consisted of a hoistman, fireman and five hookers and erectors. The equipment consisted principally of a traveling stiff-leg derrick and special lifting rigs for handling the precast units. The derrick was equipped with a 72-ft. boom and had a lifting capacity of about 10 tons.

In dismantling the old timber flume the waterway was sawed into 20-ft. sections and lifted to one side. The old flume was cleared away to the limit of reach of the derrick before beginning the erection of the precast units.

In erecting the precast units the bents and stringers were set up to the limit of reach of the derrick, after which the flume sections were lifted into position. The bents were lifted into position on the pedestals and plumbed, levels were then taken on each end of the bent cap to determine the amount of shimming necessary to bring the top of the bent up to grade. The bent was then removed. Where no shimming was necessary, the tops of the pedestals were treated to a thin coating of grout and the bent placed in position. Where shimming was required, metal shims, 1½ x 8 in. and of varying thickness, were used to support the bents until the grout had set. More than one-half of the bents required no shimming. Where shimming was necessary, it usually amounted to about ¼ in. and occasionally as much as ½-in. was required. Little trouble was experienced in settling the stringers. Occasionally one was found where the top and bottom faces were not parallel to each other and a small amount of shimming was necessary.

The rig for lifting the bents and stringers consisted of two pairs of heavy iron tongs, one pair being fastened to each end of an I-beam spreader 8 ft. long. For lifting the bent clear of the bottom form a sling fastened to the middle of the spreader was passed around the cap, the bent was then lifted to a vertical position, the sill resting on the ground, the hoisting rig was then lowered and the tongs clamped under the cap.



THE PRECAST CONCRETE FLUME IN OPERATION

Walkway at side supported on inserts at center of each flume section. Leaks were negligible, most of them closing in thirty days.

For lifting the flume sections the rig consisted of two side pieces of steel of sufficient length to permit turning the flume sections. At the upper end the side pieces were fastened to a spreader and to chains for hooking.

TABLE II—FIELD COSTS OF THE PRECAST UNITS

Item	Unit	Unit Cost	Cost per Cu.Yd. of Concrete
Sand	cu.yd.	$5.50	$2.47
Sand hauling			0.38
Crushed rock	cu.yd.	6.64	6.45
Cement and hauling	bbl.	4.65	7.42
Reinforcing steel and hauling	lb.	0.043	9.60
Reinforcing steel bending and placing	lb.	0.0089	1.94
Forms, material			3.27
Forms, constructing			1.80
Forms, moving and assembling			4.20
Labor concreting			2.71
Curing			1.14
Water, fuel, lubricants and power			0.29
Laying track			0.60
Equipment and plant charges			4.53
Total per cu.yd.			$46.80

At the lower end, 2½ x 10-in. trunnions were bolted to the side pieces. In lifting the flume sections the trunnions were inserted in the 3-in. hole cast at the center of gravity of the flume sections; the ends of the trunnions were then hooked together with a chain. The flume section first was lifted a few inches and cleared from the adjoining units. It was then lifted to a height of several feet and turned right side up by four men. The wood joint and end forms were removed and the section swung into position.

Joints—The joint used gave no trouble in erecting and was well adapted to take up slight variations in the thickness of the stringers or in the thickness of the floor slab. When the sections were set up most of the joints fitted so closely as to preclude the insertion of an ordinary table knife.

In making the joints watertight the wire mesh was first bent out and the joints thoroughly cleaned; the joint was then covered with a mixture consisting of

TABLE III—SUMMARY OF TOTAL COSTS OF "C" CANAL FLUME

Class of Work	Unit	Quantity	Unit Cost	Total
Excavation	cu.yd.	100	$2.70	$270.96
Mfg. precast units	cu.yd.	2,600	46.80	121,698.31
Leveling precast yard				7,468.47
Dismantling old flume	lin.ft.	4,226		2,007.41
Erecting new flume	lin.ft.	4,226	2.20	9,268.87
Highway crossing	cu.yd.	73	53.60	3,955.85
Grouting flume joints	each	990	4.00	3,961.75
Diversion canal crossing:				
Metal work	lb.	6,400	0.155	992.90
Concrete reinforcement	cu.yd.	9	35.95	323.34
Concrete, plain, piers				91.50
Backfill, dry	cu.yd.	100	1.19	118.80
Grouting stringers				1,949.77
Concrete struts	cu.yd.	40	47.80	1,896.97
Parallel walk, metal work				1,117.96
Parallel walk, wood work	M b.m.	5.98	27.20	162.43
Turnout gates, metal work	lb.	2,790	0.29	800.56
Turnout gates, concrete reinforcement	cu.yd.	10	35.86	358.65
Right of way				231.87
Camp maintenance				6,979.05
Engineering and inspection				3,312.38
Sub-total				$166,967.80
Flume, inlet				1,884.57
Flume, outlet				1,870.48
Flume, wasteway				4,033.85
Sub-total				$174,756.70
Superintendence and accounts				8,891.93
General expense				14,621.75
Total				$198,270.38

about 60 per cent of petrolastic cement and 40 per cent rubberoid plastic cement. The wire mesh was then bent back into position and the joint grouted. At first it was intended to cover the joint with the rubberoid plastic cement only. The process of placing the rubberoid, however, proved to be laborious and expensive, particularly on the vertical joints. After some experimenting, the rubberoid plastic was mixed with sufficient petrolastic cement to make the combination liquid when heated in a small portable 20-gal. heater.

For pouring the joints, an iron pot resembling a coffee pot was used. The bottom joints being level were easily poured. The vertical joints were poured from the top, the stream following down the joint and pouring being continued until the stream had nearly reached the bottom. Pouring was then stopped and the mixture smeared over the joint with a hot iron from the bottom up. A second pouring was made and flattened similar to the first. The asphaltic covering over the joints averaged about 1¼ in. wide and about ¼ in. in thickness. The spreading irons which were bent in the form of the letter "J" were made from an old Ford spring and were fitted with a wooden handle. With a pouring crew of three men about sixty joints were completed per day.

Grouting—Before grouting the joints were thoroughly cleaned with an ordinary blacksmith's hand blower with a short section of hose. The vertical joints were poured from the top and were spaded between the wood form and the wire mesh with a thin piece of strap iron.

The precast concrete flume was constructed and erected by government forces working under the direct supervision of J. C. Whitney, superintendent. The work of surveys and inspection was performed mainly by E. L. Stephens, assistant engineer.

An average force of about 100 men was employed from May 1 to August 15. Quarters were furnished free to the men, also spring cots and mattresses. Meals were charged for at the rate of 45 cents each. The wages paid were as follows: Sub-foremen, engine operators, blacksmith and carpenters, $4.96 to $6.72; carpenter helper and special laborers, $4 to $5, teamsters, $4; common labor, $3.60; waiters, $60 to $65.

The replacement of the Klamath flume was done under the general supervision of A. P. Davis, director, U. S. Reclamation Service, F. E. Weymouth, chief engineer, J. L. Savage, designing engineer, H. D. Newell, project manager, and the writer as engineer.

Oil and Steam Engine Costs for Small Towns

COMPARATIVE costs of oil and steam engines for furnishing a water supply and electricity in small towns were given recently in a paper by George T. Prince, consulting engineer, presented to the Iowa Section of the American Water Works Association. Mr. Prince assumed towns of 1,000, 2,500, 5,000 and 10,000 population and gave unit costs as follows, based on his own observations and various other sources:

Population	Probable Annual Output in Kw.-Hr.	Cost of Power Plant		Annual Maintenance and Operating Expense		Unit Cost per Kw.-Hr.	
		Steam	Oil	Steam	Oil	Steam	Oil
1,000	198,000	$35,300	$31,500	$13,874	$8,992	$0.070	$0.045
2,500	648,000	54,650	53,200	19,798	15,063	.030	.0234
5,000	1,300,000	82,000	91,300	30,405	26,492	.023	.0204
10,000	2,700,000	117,500	103,000	49,348	39,303	.0183	.0146

The above maintenance and operating expenses include labor, fuel and lubricating oil, repairs, 6 per cent interest on investment, depreciation based on 4 per cent sinking fund. Life of oil engines is assumed as 15 years, all other property, 25 years. Price of coal is taken at $8 per ton for 1,000 and 2,500 population towns; hand firing; evaporation, 6-1. Price of coal, $7.50 for 5,000 population; mechanical stokers; evaporation, 8-1. Price of coal, $7 for 10,000 population; mechanical stokers; evaporation 8-1. Price of fuel oil, 6c per gallon. Price of lubricating oil, 60c per gallon.

Road Grading Costs Reduced By Tractor Hauling

Plant Investment and Operating Costs Itemized for Two Heavy Grading Operations in Iowa and Missouri

By E. R. Wiggins
Holt Manufacturing Co., Peoria, Ill.

A COMPARISON of tractor-operated elevating graders with tractor-hauled four-wheel scrapers is afforded by two road-grading operations recently studied by the writer. It is possible also to give actual plant costs and estimates of the earth moving costs which are informative. In general it may be noted that these completely-motorized grading operations are becoming increasingly common in the roadbuilding of the Mississippi valley states.

Elevating Grader Outfit—In Crawford County, Iowa, a five-mile road requiring 180,000 cu.yd. of excavation is being built with elevating graders and tractors (see Fig. 3). This road, located two miles west of Manilla and forming the main thoroughfare between Manilla and Dennison, is very hilly and has grades as steep as 20 per cent. When completed all the hills will be cut down, fills made and a balance so arrived at that no grade will be more than 6 per cent. Representative cuts are 25 ft. deep, while the corresponding fills are 22 ft. high. The first estimates gave the dirt to be moved as 30,000 cu.yd. to the mile, but the actual work shows that this figure is being overrun by 20 per cent. One hill alone had over 30,000 cu.yd. to be moved. The Shirley Construction, Omaha, Neb., has the contract for this work. It is using three 10-ton caterpillar tractors, one of which is operating an elevating grader, while two are pulling 4½-cu.yd. dump wagons, two wagons to a train. A Cletrac tractor is also being used at times to pull a blade grader for smoothing and for doing odd jobs about the camp.

The average haul is very close to 700 ft. and, considering a full cycle of operations from the time of one load to the next, by the same train, takes ten minutes. Allowing for some delays that occur, 1,000 cu.yd. are hauled a day. The work is being carried on in the conventional elevating-grader manner, the 10-ton tractor pulling the grader takes a maximum cut in both directions, up and down grade. Loading is done at low speed, while the hauling to and from the dump is on high.

Including Paul Shirley, one of the firm, who acts as timekeeper, there are 12 men. The list besides Mr. Shirley follows: One foreman, who is also a specialized tractor service man; three tractor operators; one blacksmith; one cook; one plow holder; one dump man; one "skinner"; one tripper and one sloper. Mr. Shirley estimates the value of the equipment on the job to be $27,360. This is made up as follows:

3 10-ton tractors	$18,150
1 Elevating grader	1,400
4 Wagons	3,400
1 Small tractor	1,450
1 8-ft. blade grader	700
2 Mules	400
1 Tongue scraper	25
1 Ford car	400
1 Wagon for the office, has desk, beds and supplies	250
1 Wagon for the kitchen and dining room	250
1 Bunk shack	250
1 Blacksmith shop and equipment	300
1 Large tent for the mules and where the tractors are stored on rainy days	200
1 No. 5 plow	25
1 No. 2 slip plow	10
1 Incidentals, such as beds, kitchen equipment, etc.	150
Total	$27,360

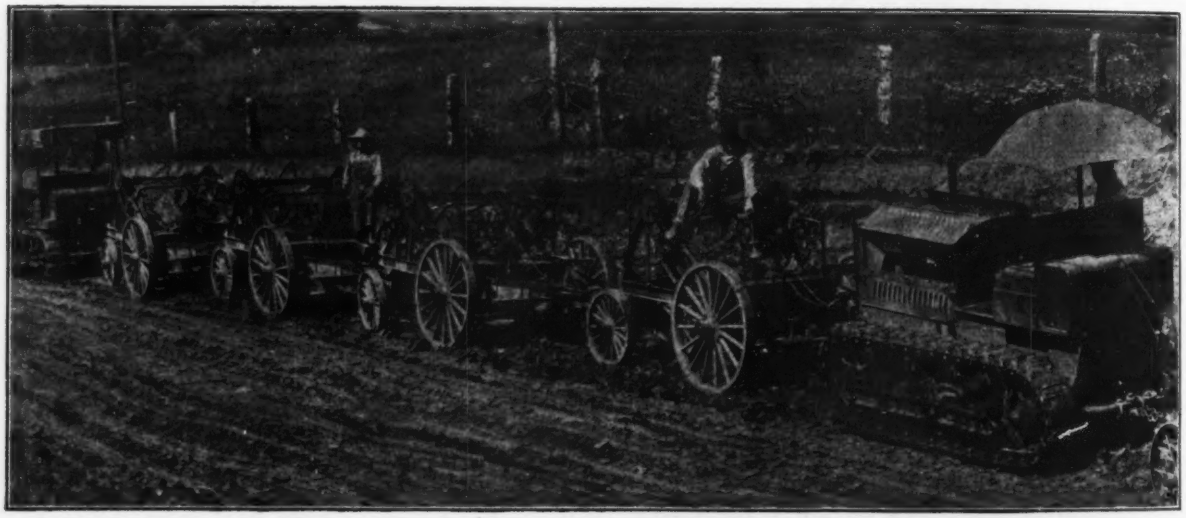


FIG. 1—TRAINS OF WHEEL SCRAPERS PULLED BY 5-TON TRACTORS

The equipment directly concerned in the movement of the dirt includes the three tractors, an elevating grader, four 4½-cu.yd. wagons, the blade grader and the tongue scraper, which in total value amounts to $23,675.

An analysis of the daily dirt moving costs on the Shirley job is as follows:

Depreciation 20 per cent on dirt moving equipment	$31.57
Interest on the investment at 6 per cent	9.47
Wages, board and lodging of operators	22.80
120 gal. gas at 22 cents	26.40
2½ gal. lubricating oil at 80 cents	2.20
Upkeep 25 per cent depreciation	7.89
Foreman	7.50
Total	$107.83

Added to this sum is the expense of dumping the blade grades and of a man and team, $6.97, making a total for a day of $114.80. On the basis of 1,000 cu.yd. of dirt moved a day, the cost per yard is 11½c. Daily depreciation is calculated on 150 working days per year and is 20 per cent of the original value. A

tractor's life is figured at four years, and at the end of the fourth year the machine is worth an amount equal to the depreciation for one year.

Wheel Scraper Outfit—In Missouri, F. L. Bondurant is completing a contract for a 5½-mile road near Unionville in Putnam County, which is a project involving the straightening of many turns, the cutting

TABLE I—COST OF TRACTOR OPERATED WHEEL SCRAPER OUTFIT GRADING ROAD

Equipment:	
4 5-ton tractors	$15,900
12 wheel scrapers	5,100
1 10-ft. blade grader }	1,350
1 8-ft. blade grader }	
1 7-ft. blade grader	700
1 tractor rooter plow	150
1 bulldozer scraper	325
1 Fordson tractor	425
1 water wagon	90
1 tool wagon	400
1 gasoline wagon	300
1 walking plow	25
Total	$24,765
Personnel:	Per Day
1 foreman at $150 per month	$6.00
4 drivers at 40 cents per hour	16.00
1 dump boss at $125 per month	5.00
6 scraper men at 35 cents per hour	21.00
Total	$48.00
Operating expense:	Per Day
120 gal. gasoline	$25.20
3 gal. cylinder oil at 82 cents	2.46
Transmission oil	.90
Cup grease	1.40
Axle grase	1.50
Total	$31.46
GENERAL:	
Depreciation at 20 per cent	$33.00
Int. on investment at 6 per cent	9.91
Repairs	10.00
Insurance 3 per cent payroll	1.44
Bond	3.00
Total	$57.35
RECAPITULATION:	Per Month
Payroll	$1,248.00
Operating expense	817.96
Depreciation at 20 per cent	858.00
Int. on investment at 6 per cent	257.66
Repairs	260.00
Insurance 3 per cent payroll	37.44
Bond	78.00
Total	$3,557.06

down of hills and the making of extensive fills. He is using four 5-ton tractors. Two of these are operating trains of four to six 1-yd. wheel scrapers; another is used with a rooter plow, keeping well ahead of the scrapers, plowing the road, and the fourth is attached to an 8-ft. blade grader.

In operating the tractors pulling the wheel scrapers, the loading is handled on low gear, and as all the

FIG. 2—REPRESENTATIVE WHEEL-SCRAPER LOADS

hauling is down grade, most of the hauls are made on high. The daily output on the average is very close to 650 cu.yd. During the month of June, 1922, this outfit worked 23 out of 26 working days, and moved 17,000 cu.yd. The average haul, from turning point to turning point, was from 800 to 1,000 ft. The loading of the scrapers is close to full capacity. According to one actual count, out of 13,300 loads, 12,400 cu.yd. of earth were moved, a difference of but 8 per cent. This figure on some counts ran as low as 3 per cent. According to one observation of time, it took 8 minutes to make one complete circuit with 800 ft. haul. Under

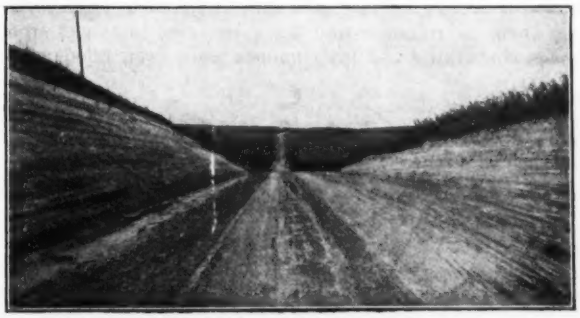


FIG. 3—REPRESENTATIVE CUT, MANILLA, IOWA

similar conditions but with a haul of 1,600 ft. the trip was made in 10 minutes. Records for one day show that one train made 59 trips, while the other made 58 trips per 10-hr. day. On the other hand, one day's run showed that 964 scraper loads were hauled. In a month's run, the average number of wheel scrapers used per day is nine.

Table I gives the equipment with its value, personnel and wages, daily operating expense and general daily expense. The final figures sum up the various daily costs into a monthly cost sheet, from which the unit cost on the basis of yardage hauled is calculated. The cost for moving this dirt is calculated from the figure of 26 days per month, because this is believed to be a fair average. If dirt was not being hauled on rainy days, other work was being done.

A.R.E.A. Committee on University Relations

In order to develop closer contact between the railways and the technical schools the board of direction of the American Railway Engineering Association has authorized the appointment of a committee for co-operation with universities and colleges. As a preliminary a special committee of the board wrote to about a hundred universities and colleges in the United States and Canada requesting suggestions as to the names of alumni to represent these institutions on the committee. The main purposes of the new committee are: (1) to arouse greater interest among railway officers in assisting the universities to turn out men with the most efficient training; (2) to give the universities the results of the work of the association's committees; (3) to acquaint employers with the qualifications of the graduate in entering railway work; (4) to stimulate greater interest in the study of railway engineering; and (5) to establish co-operation between university laboratories and the association's committees for the benefit of research work. R. H. Ford, assistant chief engineer of the Chicago, Rock Island & Pacific Ry., is chairman of this committee.

Surveying Without Instruments on Siberian Railway

Some Hints on How Topographic Work May Be Done With Reasonable Accuracy By Improvised Plane Table and Other Devices

By William Ewald
Civil Engineer, Sao Paulo, Brazil

SEVERAL times on surveys in Siberia for the Siberian Ry. and along various Siberian rivers, surveying instruments reached their destinations entirely unfit for use, in spite of precautions taken to transporting them by reindeer and dogs. In some instances, the boxes containing the instruments were even filled with

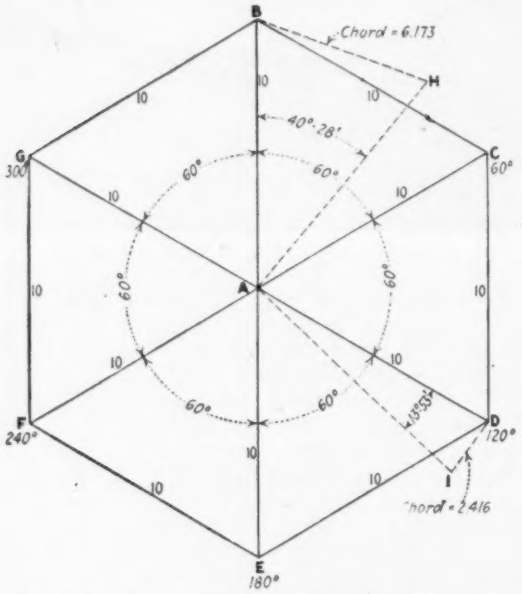


FIG. 1—METHOD OF MEASURING ANGLES

tallow or wax, but even such provisions proved inadequate. There was no assurance that a duplicate set of instruments would not suffer the same fate and on the other hand valuable time would have been lost in waiting for them, so in order to avoid complete cessation of the whole work, it was decided to make surveys without any precise instruments or even without an exact unit of measurement.

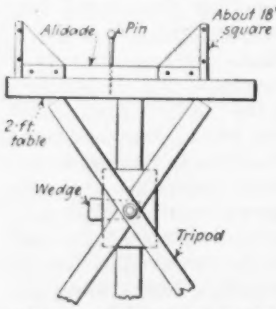


FIG. 2—HOMEMADE PLANE TABLE

A great amount of photographic work in the region above mentioned was actually done by homemade devices which included a plane table and other rude instruments.

Linear Measurements—First, a unit of measure was established in the following manner: A rod about 5 m. long was cut from a young pine tree and subdivided into small equal parts, the smallest subdivision being about a millimeter in length. After one was available, this unit of measurement was checked up against the official Russian measuring tape and all calculations on plans reduced to the Russian standard, the sajène. For measuring longer distances a cord made of horsehair was used. Hemp or cotton was found to be subject to too much change through dampness.

Angular Measurements—Horizontal angles were measured by measuring the chords. A maximum error of two minutes was allowed. The method in which the angles actually were measured is indicated by Fig. 1.

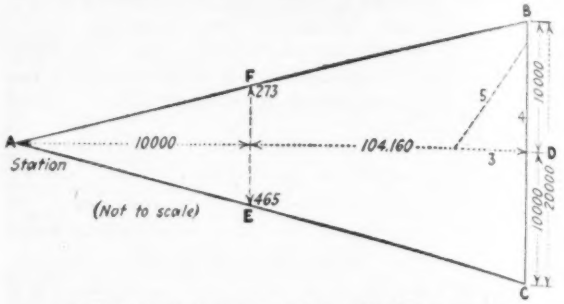


FIG. 3—METHOD OF LINEAR MEASUREMENT

A triangle of wire of equal sides, each of 10-unit length, was made with a thin rod, large nail, or a piece of thick wire placed at each corner. By placing one point of the triangle on station *A*, points *C* and *B* were established and in like manner points *D*, *E*, *F* and *G*. On this large limb it was found easy to measure chords of any angle around station *A* within the two-minute limit.

For instance, in order to measure angle *BAH*, the ten units from *A* to *B* were taken in the direction of one of the sides and *AH* is the direction of the other side, then the length *BH* marked by thin pegs was found to be 6.173. By a simple trigonometric calculation this chord is found to subtended by an angle of 40 deg. 28 min. For a larger angle, such as *BAI*, the chord from *B* to *I* was measured, the angle calculated and added to the known angle *BAD*.

Another manner in which angular measurements were made was by the use of a homemade plane table. This plane table was composed of a tripod modeled after the field seat used by landscape painters surmounted by a plane table about 2 ft. square laid loosely on the tops of the tripod legs. A wooden alidade without any slot or sighting hair, but with two exactly equal wings, allowed horizontal angles to be measured along the vertical sides of the wings and vertical angles along the tops of the wings. A sheet of Whatman paper was pasted on the table, a pin set in the table on the station point, and pencil lines traced along the edge of the paper through the entire table's width.

Measurement of distances with the alidade without using stadia methods was affected in the following manner: Referring to Fig. 3, on both sides of the point *D* mark the points *B* and *C* at ten units each. The right angle *BDA* is secured by a wire or tape and the 3—4—5 method. Short rods with black and white targets capable of being seen a mile distant were placed at *B* and *C*. At ten units from *A*, a scale with small graduations about a millimeter in length was held horizontally on a wire the other end of which was attached on the peg at *A*. In order to avoid this rule shifting horizontally, it rested on two rods in the ground. Readings were taken across this horizontal scale from *A*, sighting at the targets *B* and *C*. Points on the scale intersected by these sights were the read-

ings, say 273 and 465, whose difference (192) was the quantity corresponding to the distance 104.16. In the calculation of these distances, a simple use is made of the geometric relationship existing between similar triangles. Should this distance be measured on an inclination, it must be reduced to the horizontal by multiplication of the cosine of the angle as obtained by the leveling process hereinafter described.

Leveling—Level readings were usually taken with a homemade plumb device which consisted of a rectangular wooden frame (see Fig. 4) *ABCE* resting on a triangular wooden pivot *D* and weighted so as to be normally in a perpendicular position. The upper face of the device was planed so that readings could be accurately taken along the edge. The pole supporting this rectangular frame was driven into the ground firmly but still free enough so that it could be revolved at

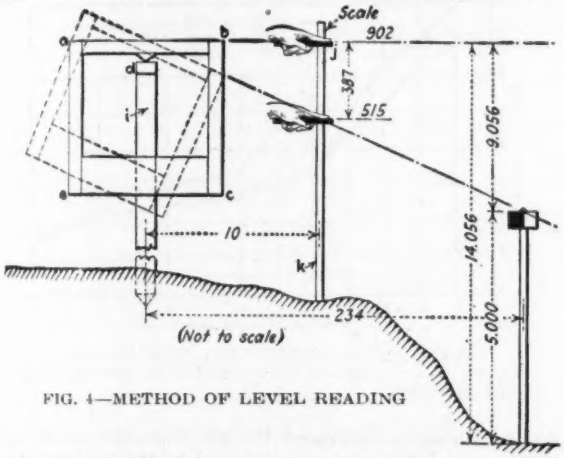


FIG. 4—METHOD OF LEVEL READING

will. By sighting first at the top of the rod (which in this case was 5 m. long) the rod reading was established. Then by a scale held ten units from the level device a reading was first taken with the table in a horizontal position and then at the top of the rod target, with the rod resting on the ground. The distance thus intercepted on the scale, together with the known ten units distance of the scale from the level and the height of the horizon above the target top, established the necessary ratios so that by simple trigonometric calculations all wanted data were secured.

Inasmuch as the sights along the edge of the plumb device might not be exactly horizontal, second sights were taken with the frame turned in a reverse position.

Canadian Water Power Report for 1922

A statement issued by the water power branch of the Canadian department of the interior shows that during 1922 approximately 3,000,000 hp. of electricity was developed from Canadian waterfalls. Of this total, about 1,330,000 was in Ontario; 1,100,000 in Quebec, 310,000 in British Columbia, 110,000 in Manitoba and the remainder in Alberta, New Brunswick, Nova Scotia and Prince Edward Island. The total capital invested in these enterprises is $620,658,731, and the estimated revenue is $81,600,000. The equivalent coal consumption at 9 tons per annum per installed hp. would be a little over 26,725,000 tons, which at the average price of $10 per ton would cost $267,250,000. The use of the water power is divided as follows: central stations, 2,165,000 hp.; pulp and paper mills, 484,288 hp.; other industries, 320,561 hp.

Milwaukee Activated-Sludge Plant To Use Vacuum Filters

By T. Chalkley Hatton
Chief Engineer, Sewerage Commission, Milwaukee, Wis.

FOR reasons stated below, vacuum filters are to be used as a part of the dewatering equipment of the Milwaukee activated-sludge plant. The sludge will be conditioned by heat and sulphuric acid before it goes to the filters and will pass from the latter to driers. The contract for the filters, receivers and condensers has been let to the Oliver Filter Co. for $324,047. It calls for 15,000 sq.ft. of effective filter surface, which will be provided by 30 drum filters, each 12 ft. in diameter by 14 ft. long.

For five years we have been testing out various types of apparatus for removing the water from the activated sludge. This apparatus has consisted of presses of several types: the Berrigan, Simplex, Johnson low-pressure and Johnson high-pressure and the Worcester. Three types of centrifuges have been used: the Sharples separator, open laundry centrifuge and the Besco-ter-Meer.

Filter cloths of many kinds have been tried, grading from coarse India hemp to fine cotton twill. We have used pressures from zero to 6,000 lb. per square inch. The sludge, prior to dewatering, has been conditioned in many ways, such as increasing the temperature, adding sulphuric and sulphrous acid, sulphate of alumina, Sil-O-Cel, peat, ground garbage clinkers, and a few other things. Records have been taken to determine cost and applicability.

Finally, a year ago, after experimenting with vacuum filters in the laboratory, and a vacuum pan, we installed an Oliver filter, 36 in. in diameter, and operated it up to Oct. 1, of this year under the immediate supervision of George S. Backus, engineer for the Oliver Filter Co.

It took several weeks to ascertain how to condition the sludge to get any promising results from the vacuum filter. This filter had been tried out at Champaign, Ill., under Dr. Edward Bartow, and had been abandoned. It was learned at Milwaukee that when the sludge was properly conditioned by raising its temperature before reaching the filter from its normal (whatever that might be) to from 120 to 180 deg. F. and keeping its pH value within the limits of 3.3 to 4 by means of sulphuric acid the filter would produce about 65 lb. of sludge per 24 hours per square foot of filter cloth surface, reducing the moisture content from 99 to 80 per cent, and that it would do this all the time regardless of the character of the raw sludge. The filtrate produced had a bacterial content of about 100 per c.c. which permits its discharge into the river without further treatment. It was also ascertained that the life of the filter cloths used in the vacuum filters was much greater than that of the filter bags used in the presses and that the cloths could be cleaned mechanically without being removed from the filters, and that the operation of the filters required fewer men than either type of press.

The Oliver filters require two different vacuums—22 and 11 in. The first is used for pick-up and the other for water withdrawal. That is, as the filter drum revolves through the sludge one vacuum pulls it to the surface of the cloth whereas the other withdraws the water from the film of sludge after it leaves the wet sludge. This requires two separate sets of vacuum

pumps, receivers and condensers. The conditioning of the sludge before filtering is effected by discharging sulphuric acid in the raw sludge as it enters the centrifugal pumps. This is automatically controlled from predetermined standards.

The hot filtrate at a temperature of between 110 and 130 deg. F. is returned from the filters by gravity and passes through heat exchanges on the outer surfaces of the tubes, whereas the cold acidified sludge passes through the tubes and thence through pre-heater tubes around which the exhaust steam from a 1,250-kva. noncondensing steam-turbine-driven generator passes. By this means the heat used in the conditioning is preserved so far as possible and the extra heat required is secured. The current produced by the generator is used to drive the motors in the filter house and drier house, the balance being sent to the main bus bars in the power house to which are connected three 625-kva. condensing turbine generators.

As the sludge cake leaves the filters it is to be conveyed directly to the drier house immediately adjoining the filter house where it is ultimately mixed with partly dried sludge, or that which has once passed through the drier, and goes from thence to the driers.

Experiments on Formation of Floc for Sedimentation

Factors of Velocity and Time Studied at Baltimore With Hydrogen-Ion Concentration Held Constant

By Edward S. Hopkins
Chemist, Montebello Filters, Water Department, Baltimore, Md.

WHAT is the proper velocity of flow and time of passage of water through a mixing basin, after adding the coagulant, to produce good sedimentation? Results are given in this article of experiments made to obtain some information as to the little known conditions favorable for the formation of floc for sedimentation. One factor, the pH value, for good control has been fairly definitely established. (See Baylis—*Journal* American Water Works Association, Vol. 9, No. 3, 1922; Buswell—*Journal* Industrial Engineering Chemistry, Vol. 14, No. 9, 1922, and others.)

Studies and observations suggested by James W. Armstrong, filtration engineer, were carried out in the concrete-covered mixing basin of the Montebello filters, Fig. 1, which is 118 ft. wide, 191 ft. long and 18 ft. deep. The wooden baffles forming the channels are supported by concrete columns. Each of the 24 channels or "turns" is 8 ft. wide. The total distance traveled by the water is 0.56 mile and the time required for passage is 31.8 min. at the nominal 128-m.g.d. rate. The head necessary to force the water through the basin is 3.3 ft. As the bottom of the basin is level and the channels are of uniform width, the depth of water is decreased and the velocity increased from 1.3 ft. per second at the entrance to 1.6 ft. per second at the outlet.

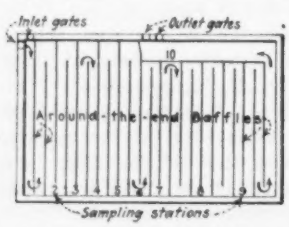


FIG. 1—MONTEBELLO MIXING BASIN
Showing the arrangement of the sampling points

Manholes in the roof served as sampling stations. Station 1 is at the first "turn" or beginning of the mix while Station 10 is at the point of entrance to the settling basins. The other samples came from intermediate points.

No precise method of measuring the time required for sedimentation has been recorded but, for the purpose of this study, the time required for each sample standing quietly to settle until its turbidity equalled that of a comparative sample from the effluent of the settling basin was adopted as the method of procedure. The settling basin sample was taken at the same time as the test sample and the clarification determined simply by the eye.

This study covers turbidities from 5 to 500 p.p.m. and a temperature variation of from 33 to 78 deg. F.

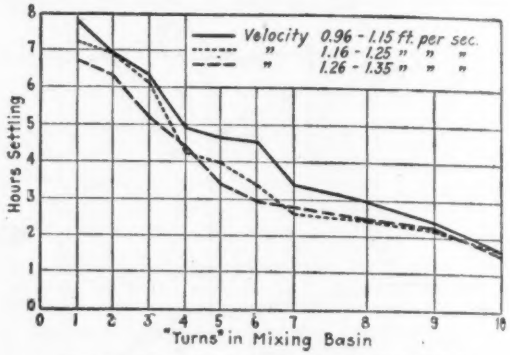


FIG. 2—RATE OF SETTLING OF SAMPLES
Samples from Station 10 always settled in shortest time, at all velocities.

As the turbidity increased the pH value decreased but pH' was maintained as a minimum in the basin by the addition of lime when necessary. The results presented give averages of 56 tests made at reasonable variations in turbidity for a period of 10 months dating from July, 1921.

One-liter samples were collected in beakers placed on a carriage at the end of a pole and submerged 2 or 3 in. below the surface. A single sample was collected at each station, beginning in every instance at "turn" 1 and proceeding rapidly to 10. The pH value by the colorometric method was determined and the samples allowed to stand quietly until their turbidity equaled the comparative standard. It is advisable to collect the samples in the same beakers in which they are allowed to stand, because pouring from one vessel to another breaks the floc and produces erroneous results.

The hydrogen-ion concentration did not vary (pH ± 0.1) through the basin. This test was used to establish the uniform application of chemicals in preference to the alkalinity or carbon dioxide determinations because of its rapid manipulation and absolute reliability. A water giving a definite pH value at "turn" 1 mantained the same value at every point in the basin. This condition indicates immediate establishment of the equilibrium of the chemical reaction.

Samples from station 10 having been collected after passage through the basin always settled in the shortest time. The others settled in a proportionately increased time, the length of time depending upon their coagulation.

Realizing that samples with the low turbidities, 5 to

25 p.p.m., are composed of finer particles than those of greater turbidities, 100 to 500 p.p.m., it was thought that comparative rates of sedimentation would be obtained by plotting the time of settling for each station in groups corresponding to the turbidities of the samples. No relative curve could be obtained.

As there is apparently no relation between the time of sedimentation and samples of equal turbidity, the factor of velocity was next considered. Various linear velocities were plotted against the time of sedimentation. Curves in Fig. 2 were plotted showing velocities of from 0.96 to 1.15, 1.16 to 1.25 and 1.26 to 1.35 ft. per second. A study of these curves shows that regardless of turbidity or variation of the velocity, within the limits of this study and with the pH value constant, after a definite time of mix and after traveling about one-half of the basin, the lines converge toward a common center and steadily draw closer together until the last "turn" is reached. Therefore after the thorough mixing of the coagulant, alum, and the water, with the chemical reaction established, further mixing will produce a more readily settleable floc.

Conclusions—It is clearly seen that the first few "turns" produce a fairly good mix but since it requires less time for sedimentation at each subsequent "turn," it is obvious that each "turn" has a value toward decreasing the time of sedimentation. This theory is

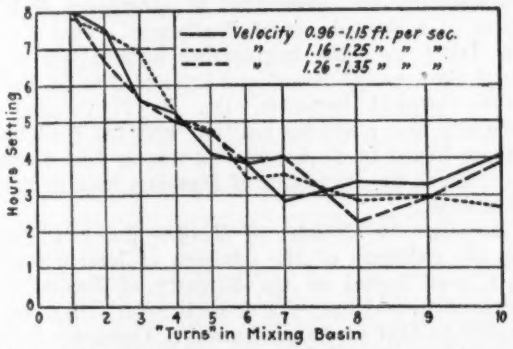


FIG. 3—RATE OF SETTLING WITH BAFFLES REMOVED
Baffles 6, 7, 8 and 9 were partially removed to permit short circuiting.

strengthened by a study of Fig. 3. Portions of the baffling at "turns" 6, 7, 8 and 9 were broken, allowing a short circuit of the water without proper mixing. It is easily seen that there is no correlation between the two curves with the exception of the line represented by the velocities 1.26 to 1.35, which falls steadily. The theory may be advanced that the rapid flow produced the required mixing and caused the formation of a uniform floc.

These studies show very clearly that good coagulation was obtained under all conditions and that two factors contributed to the result. The higher velocities produced a floc that settled out more readily in the first six or seven "turns" and, although the velocity increased gradually throughout the basin and subsequent "turns" have a decided value in forming a floc that will settle quickly, these higher velocities are of less value as the water approaches the last "turn."

Since the subsiding value at the last "turn" is practically the same for all velocities the time element is also of considerable value in securing a proper floc. It was not possible to learn the relationship between these two factors at this point as there is no way of eliminating the unknown variable.

Increased Application of Venturi Flume

VENTURI flumes measuring water to farmers are installed on the Milk River Project of the U. S. Reclamation Service, in four sizes. Their use is augmented by the insertion of a plug to measure small flows. H. Kenneth Smith, assistant engineer of the project, in the November *Reclamation Record* tells of them as follows:

Gage heights are measured with a hook gage from nails driven in the sides of the gage walls. The hook gages are made from strap iron ¼ x 1 in., graduated by hundredths to 2 ft. Each ditch rider carries one of these hook gages as a part of his regular equipment and uses it as a 2-ft. rule for various purposes.

The discharge is determined from a semi-logarithmic chart, with upper gage heights and draw, or difference in gage heights, as co-ordinates, the discharge in second-feet being read on curves. The sheets are drawn of a size to fit the standard time-book cover of the Reclamation Service.

Operating conditions on an irrigation project often require that a small quantity of water be delivered through a ditch of considerably greater capacity, and at the same time it is required that the water be backed up until the ditch is practically bank full.

Generally it is not practical to instruct a ditch rider to read gage heights to a refinement greater than one-hundredth of a foot, and an error of one-hundredth is quite common. The problem, then, is to construct or modify the Venturi flume so that an error of one-hundredth in gage reading would not be material when delivering water to the farmers.

This difficulty is overcome by installing a plug in the throat of the flume, thereby reducing the water area. This plug consists of two weir boards bolted together, the sharp edges of both boards being toward the throat. A bolt with a thumb nut holds them in place.

These plugs can be placed in the flume or withdrawn while the ditch is in operation. Care must be used that the plug is snug against the bottom of the flume and so tight that it will not float or otherwise become dislodged.

By means of this plug a flow that in the standard design will cause a draw of one or two hundredths will now cause a draw of ten to twelve hundredths and is therefore a measurable quantity. An error of one-hundredth in reading at ten or twelve hundredths is of much less moment than the same error at one or two hundredths.

Four sizes of the Venturi flumes are in use on the Milk River project, having throat widths of 12, 18, 24 and 30 in. For the 12- and 18-in. sizes the height of the plug used is 9 in. and for the two larger sizes the height is 15 in.

These plugs have proved quite satisfactory and have greatly increased the accuracy of the measurement of water on this project.

Piezo-Electric Measurement of High Pressures

A new method of measuring high pressures or rapidly varying forces is discussed in a paper of the Bureau of Standards by J. C. Karcher. If several circular quartz plates are cut from a crystal and placed with an electrical axis perpendicular to them or assembled with metal plates between to form a condenser, any pressure applied to the stack of plates will liberate a charge proportional to the pressure applied, and this charge will appear as a current at the condenser terminals. When the current is measured by a galvanometer and the galvanometer deflection is photographed on a moving film, the pressure may be determined as the slope of the deflection-time curve multiplied by a suitable constant. Experiment has shown that the quantity of electricity liberated by the quartz plates is proportional to the pressure applied, up to pressures of 50,000 lb. per sq.in. Pressure measurements in guns have furnished a check on the action of this new form of gage.

The Present Status of Sewage Treatment in England—I

Impressions Based on Visits to Various Works and on Interviews with British Specialists in January, 1923, Presented with a View to Current American Problems

By George W. Fuller
Consulting Engineer, New York City

This is the first of three articles written for "Engineering News-Record" by Mr. Fuller directly after an inspection of a number of British sewage-works. After the general introduction, the Impressions are grouped under three heads: I. Administration and Policy Questions. II. Status of Older Types of Treatment. III. Outlook for the Activated-Sludge Method. In the present article Mr. Fuller treats of war and post-war handicaps and the present improved outlook. The current British practice of adopting works and methods that will give results commensurate with their cost is held up as worthy of world-wide adoption. The success of a modified decentralized control of stream pollution in England by river conservancy boards for drainage districts instead of the customary political subdivisions, is commended to American consideration.—Editor.

A VISIT of a couple of weeks in England is sufficient to show that sewage treatment practice there has entered a new and interesting period. During the war there was but little construction; in fact, during the last year or two preceding the armistice almost no plant extensions were sanctioned by the military establishment, which required for its own needs practically all available funds, personnel, materials and supplies. Consequently, the operation of sewage-works fell to a low ebb. In some cases there was no pretense of operating pumping stations or treatment works which were turned over to a minimum number of caretakers. In other instances the works were operated with perhaps one-fourth of the normal personnel and with the older, particularly the technical, members of the staff doing the work of machinists and of foremen. Women and German prisoners were availed of at some of the larger works. At some cities trade wastes, associated with military needs, increased while the output of other plants decreased. Constancy in the composition of the flow of outfall sewers became lessened to a degree which varied in different places and at different times and which is probably a factor worthy of note in some instances at present.

War Handicaps—Generally speaking, the English sewage-works got along during the war as best they could, considering the various handicaps under which their managers had to operate them. Ordinarily tanks at industrial works were operated on a plain sedimentation basis by persons not useful in military service. Rivers Boards and Conservancy Boards did but little in the exercise of their jurisdictions and a large proportion of their inspecting staffs joined the colors. In consequence of these factors many of the English rivers became more polluted than they had been for some time previous to the war, and neglected upkeep of the sewage-works caused many of them to reach a deteriorated condition not fully contemplated in earlier years.

Since the armistice real progress has been made in getting old plants back into working condition; in extending and bettering old works; in going forward with the construction of new works that were interfered with by the war; and in projecting new undertakings to supersede old ones. All of this has been done in the face of many unusual conditions. Construction costs are now from 80 to 100 per cent above pre-war prices and at times costs have been 200 per cent above pre-war figures. Tax rates are high and unemployment quite widespread.

The new Ministry of Health has taken over the functions of the old Local Government Board and all bond issues for the construction of sewage-works are predicated upon the sanction of this Ministry which has the power to disapprove the plans offered by local authorities. Approval of plans by this ministry is necessary except in cases where the projects are to be paid for by funds obtained in other ways than by loans (such as from local "rates" or taxes); or where the larger communities are proceeding in accordance with the terms of a Special Act of Parliament. This ministry has taken over the engineering organization of the Local Government Board and has added to its staff, as chief chemical inspector, Dr. H. T. Calvert, who formerly held a similar position with the West Riding Rivers Board in Yorkshire and who is best known in America as the translator of Dunbar's book on Sewage Treatment.

Hearings by Ministry of Health—Rules of Practice for the guidance of the advisors of local authorities have been issued by the Ministry of Health, which conducts formal hearings at each locality in a manner similar to that of its predecessor. Loans for building sewage-works are sanctioned when the plans provide for plant loadings in conformity with the requirements of the former Local Government Board, and these in turn are based on the findings set forth in the well known reports of the late Royal Commission on Sewage Disposal. The single exception deals with the newly developed method of activated-sludge treatment. The Ministry has sanctioned a number of loans for works of this type, usually to supplement overloaded plants of other types. Like everyone who is keenly interested in sewage treatment it is collecting and collating data to throw light on the essential elements for the successful application of this process. The information is coming from local authorities and river boards, however, as the Ministry has no laboratory or testing station of its own.

Sufficient has been said to explain the general situation. The progress in re-conditioning old works, in making decisions for installing new works, and in formulating programs for present and future developments, has been adequate for making some generalizations of interest to American sanitarians. These comments may be conveniently arranged under three headings: I. Administration and Policy Questions. II. Status of Older Types of Treatment. III. Outlook for the Activated Sludge-Method.

Administration and Policy Questions

As a first step towards getting sewage-works back on a fairly satisfactory basis of performance, local administrations have dealt with means for overcoming the abnormal amount of deferred maintenance incident to war-time interruptions. Naturally this has varied much in kind and degree at different places. Mechanical equipment was unprocurable during the latter part of the war and has been a factor of reconditioning in some measure. However, the principal undertaking has been to wash and restore clogged filter beds. This has involved contact beds, apparently of all kinds and sizes of materials, and also sprinkler or percolating beds of comparatively fine material. Just where to draw the line as to size of material in sprinkler beds which have been in service for fifteen to twenty years without clogging and those which have become seriously clogged is not a simple matter. But I should judge that little or no clogging of a permanent nature, due to sewage solids, has occurred in beds where the material was freed from particles passing a ¾-in. screen.

A second feature of local policy has been to make use of existing works so far as advantageously practicable. This natural step is shown by the general practice of installing activated-sludge plants in existing tanks or beds; by the conversion of contact beds to sprinkler beds; and by the substitution in the latter of coarse as compared with fine material, and the addition of humus tanks which are needed to follow beds of the former but not the latter type.

Associated with work of maintenance and betterments at existing sewage-works has been the task of furnishing, at some places, employment for unskilled workers. Perhaps this obligation has caused some managers to carry forward their work of rehabilitation to an extent greater than they might otherwise have recommended, although in some instances such work will lead most quickly to the securing of a fairly satisfactory effluent.

Results Commensurate with Cost—In all countries and at all times engineers have sought and should seek the adoption of works and methods that will give results commensurate with their cost. In England today, with its heavy tax burdens, it seems to me that more than ordinary attention is being given to this question of policy. Presumably it explains why some managers are making haste slowly in revamping existing works so that they may investigate new developments, such as the activated-sludge method; and thus allow themselves to come to a satisfactory conclusion as to whether a given performance of sewage treatment, in point of quantity and quality, can be more economically secured by reconditioning existing works or by installing new ones. Certainly this "performance-commensurate-with-cost" policy explains why the time-honored method of chemical precipitation has given place completely and, I believe, permanently to plain sedimentation.

At London this change was adopted some ten years ago on the advice of Fitzmaurice and Humphries and since the war has been adhered to by the latter, notwithstanding that during the very unusually dry summer of 1921 the dissolved oxygen is understood to have disappeared at intervals from the lower stretches of the Thames. Presumably there were some local smells but they evidently were regarded as of insufficient significance to justify the cost of chemicals or to interfere with the policy adopted before the war of carrying out an extensive program of building relief sewers to eliminate cellar-flooding in various low areas located some distance from the Thames and in which local sewers have become overloaded by storm water. The cost of this London County Council program for relief sewers was estimated at about £3,000,000, pre-war basis. It has been about one-third completed, although of course the cost of work done greatly exceeds one-third of the original estimated cost. As this work progresses tests are being made with the activated-sludge method at Crossness, the southerly London treatment plant, to secure data indicating what it would cost the County Council to adopt the latest type of treatment. In this way sound conclusions may be reached as to how reasonably available funds may be expended to do the most good.

Indicating and Recording Appliances—A visit to ten or a dozen sewage-works leads to the view that they are well equipped with good mechanical appliances for indicating and recording needed quantity data, as well as with good laboratory facilities such as have characterized English sewage-works for many years. It is quite possible that this view may be predicated on contact with works which are better managed than the average English sewage-works. However, it is a pleasure to record my appreciation of the carefully planned auxiliary equipment and devices installed by Hart at the new works at Leeds, and of the unique plant built by Garfield at Bradford for recovering grease from the local sludge. At the present time it is particularly important for the managers of English sewage-works to secure sound and adequate records showing the performance and condition of the various plant units, in order to know how best to proceed with improvements. In America there are some sewage plants where daily records are excellently kept but generally speaking I doubt if these records compare favorably with those secured by the managers of corresponding English sewage-works. Perhaps this offhand comment is unduly influenced by my observation that after sewage-works in America have been in service for a few years there is frequently a lessening of interest and support at the city hall, with the result that the management and records fall to a level below that of corresponding water and electric plants.

Rivers Boards or Conservancy Boards control in several districts the pollution of all streams in one or more major watersheds. They have the authority to jack up the performance at both private and public sources of pollution and they do not recognize city, borough or county boundary lines. Until they came into existence some twenty-five to thirty years ago comparatively little was accomplished towards lessening the pollution of English rivers, following the passage in 1876 of the Rivers Pollution Prevention Act, specifying certain maximum chemical limits for the impurities flowing into the streams. It was found that town authorities and directors of industrial works were very loath to spend substantial sums of money to correct pollution, in the absence of court decisions establishing the existence of nuisances caused by them. Neither was adequate incentive to initiate needed betterments forthcoming from the central authority, the Local Government Board at London, constituted to regulate the issue of loans with which to pay for the installation of works reasonably in conformity with local needs and the current state of the art. Into this breach came the

district boards, supposed to represent each class of party in interest, and which slowly but surely brought about a decided improvement in the condition of English rivers and their tributaries, especially in the manufacturing sections.

These river boards were comparatively passive during the war but now their activities are again coming to the front, with indications that additional boards may be established to operate in watershed areas not at present receiving the benefit of co-ordinated direction of means for generally controlling pollution. It appears that a new agency is examining into the condition of English streams, the Ministry of Agriculture and Fisheries. I understand that in April hearings are to be held in respect to the formation of a Rivers Board for the Valley of the Trent, the headwaters of which are in the heart of the pottery district, where coal measures have been developed because the river is at times prejudicially affected by coal washings, and in an acid condition for a distance of two to four miles below Stoke. Lower down the valley are the activities of the important Drainage Board of Birmingham.

Limited Decentralization Deserves Study in United States—What the outcome may be in this particular instance I do not know. But generally speaking it is my judgment that these district boards constitute one of the sanest and most efficient factors of the English system for the control of river pollution. They provide decentralization to the extent of putting administrative authority into the hands of a local resident agency, constituted of representatives from city, borough, county and private business interests. And yet the board comes in no way in conflict with the central authority, with whom it can co-operate to mutual advantage. It can act as an effective whip on the town authorities. In particular does it effect co-operation with, rather than opposition from, the owners of mills and other private business establishments. While such district boards cannot hope to bring about the elimination of all objectionable pollution in a large valley in the course of a very few years, for financial if for no other reasons, yet they constitute in my opinion the most rational basis of procedure yet devised for steadily bringing about the progressive installation of important works, involving the expenditure of substantial sums of money by a multiplicity of public and private interests. In America there are some localities where such district boards could overcome the limitations resulting from interstate complications and could facilitate needed support from the business interests related to the problem by giving them the representation to which they are entitled on the administrative board. Where real action is sought for controlling the pollution of streams, not readily responsive to the jurisdiction of a state department of health, it will be well to study carefully the history of rivers boards in England.

Post Office Bill Would Encourage Aviation

In an effort to encourage commercial aviation, the Senate committee on postoffices and post roads has recommended the passage of legislation fixing the rate of postage on air mail of not less than eight cents for each ounce or fraction thereof, and authorizing the Postmaster General to contract for the transportation of mail by aircraft at a rate not exceeding two mills per pound per mile. At present no additional charge is made for the mail which is carried by airplane.

Special Structural Features of San Francisco Theater

Auditorium Unusually Wide, Thin Balcony and Gallery Reduce Height—Combined Footing and Retaining Wall Saves Expense

By Zara Witkin
Civil Engineer, San Francisco

FOUNDATION and gallery structure design of particular interest are embodied in the recently completed Curran-Shubert theater in San Francisco. To save in height, already reduced by the general arrangement of the ground plan, extremely slender balcony and gallery sections were designed, and these made it necessary to provide special girders with several bends in their flanges, in order to fit into the shallow floor sections without column support. In the substructure a considerable saving was realized by a combined wall

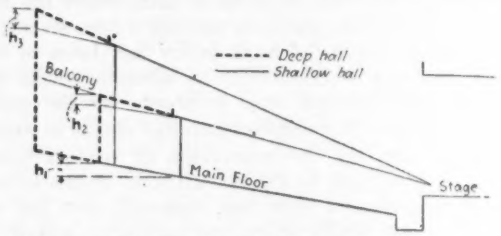


FIG. 1—THEATER HEIGHT RELATED TO DEPTH

and column footing, so worked out as to constitute a retaining wall at the same time.

A total of 14 ft. of height was saved—about one story height of an ordinary building. Most of this was due to planning the theater with a wide, shallow auditorium. The plan was worked out with a view to having each seat as close as possible to the stage, and to do this the hall was made unusually wide with respect to the length. For a total seating capacity of 1,800 the auditorium has

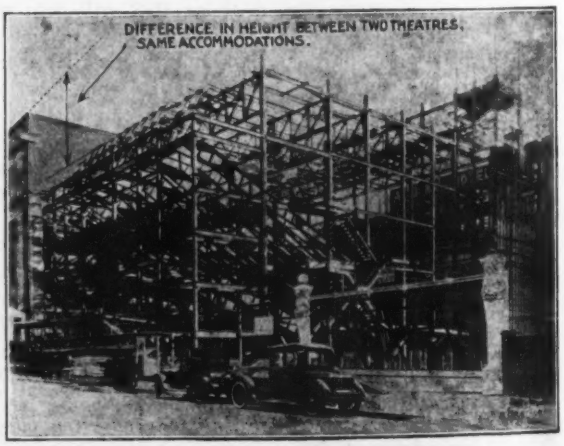


FIG. 2—ONE STORY OF HEIGHT SAVED
Curran Theater, in foreground, has balcony and gallery like the older Columbia Theater alongside, in the background, but is a full story lower, because of its wide auditorium and thin floor sections.

a width of 90 ft. and a length along the center line of only 63 ft., giving a ratio of length to width of 0.7, which is considerably smaller than that of most theaters.

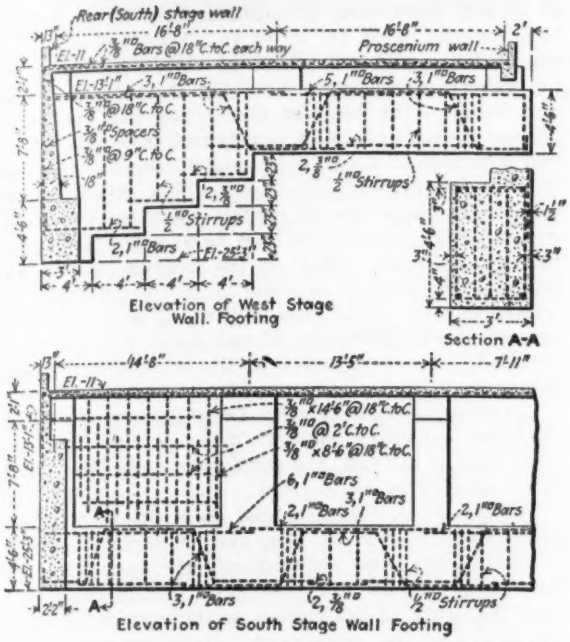

Rear (South) stage wall
Proscenium wall
Elevation of West Stage Wall Footing
Section A-A
Elevation of South Stage Wall Footing

FIG. 3—CONCRETE GIRDER FOUNDATIONS AT STAGE
South or rear wall also retains 14 ft. depth of earth inside stage space.

The effect of this arrangement on the height is indicated in the sketch, Fig. 1, which represents a comparison of a deep hall with a shallow hall. It will be seen at a glance that the deep hall has the greater height by three items: h_1, the added height on the inclined main floor, extended; h_2, extra balcony rise over that of the main floor; and h_3, extra gallery rise over that of the balcony. The sum of these items, increased by what was saved through the use of thin balcony and gallery sections, made the total saving stated.

Special structural treatment is generally necessary for a theater owing to its individuality of arrangement and to architectural details. The fundamental condition of unobstructed vision from all parts of the auditorium requires the elimination of interior columns as far as possible, and the designing of girders and trusses for transferring the interior loads to the area limits of the building. These members are affected by difficult requirements of clearance, headroom, provision for transverse corridors and similar other factors. The effect of carrying interior loads to the outer limits of the structure is to produce large column concentrations, creating in some cases special foundation problems. The design of a typical, practically standardized office building rarely involves similar special considerations.

Special Foundation—The rear stage wall of the building extends down to a level of 25 ft. 3 in. below the natural ground surface. This wall is 105 ft. 10 in. long, the full width of the building. Under the stage the final ground surface is 11 ft. below natural surface, making the net retained height 14 ft. 3 in. There are eight rear wall columns, with loads varying from a minimum of 155,000 lb. to a maximum of 235,000 lb., spaced 13 ft. 5 in. to 15 ft. 10 in. apart. The piers for these columns run down from the bases to the footing and act as counterforts for the combined bearing and retaining wall. The wall between these column piers is a reinforced cantilever slab increasing from 8 in. in thickness at the top to 18 in. at the junction with the footing, and is restrained at the sides by the counterfort piers. The counterfort column piers and the retaining wall are integral with the combined footing (Fig. 3), which is designed as a reinforced-concrete inverted continuous beam for a uniform soil pressure of 4 tons per square foot, the imposed column reactions and a wall load of the first story.

The continuous footing beam of 7 spans has a total length of 105 ft. 10 in., a width of 3 ft. and a depth of 4 ft. 6 in. Over the end spans, the main bending reinforcement is nine 1-in. square bars. Shear reinforcement is provided by ½-in. square bar double stirrups spaced 6 in., from third-points to ends of spans.

This design for the retaining wall, with the column piers acting as buttresses and the combined continuous beam footing, was adopted as the most economical and practical means of avoiding large eccentric spread footings under the columns (the adjacent property prevented symmetrical footings) and a heavy gravity retaining-wall section between the column piers and footing. In consequence, trenching and excavation were greatly reduced, form work was cut down and simplified, and the placing of reinforcement and concrete pouring was made continuous and systematic.

The side walls of the stage also rest on continuous-girder footings. The west stage wall footing, 35 ft. long, is brought up in four steps from the level of the rear wall footing at 25 ft. 3 in. to 17 ft. 7 in. being 3 ft. thick throughout its length. The east stage wall footing is only 2 ft. 2 in. thick and is stepped up in three stages to a bottom level of 19 ft. The steps necessitated breaking the bending reinforcement, which was placed in several levels corresponding to the steps. All other footings in the structure are simple concentric spread footings.

Auditorium Floor—Sloping a little over 4 ft. in 53 measured along the center line of the auditorium, the floor slab transmits its load of 145 lb. per square foot

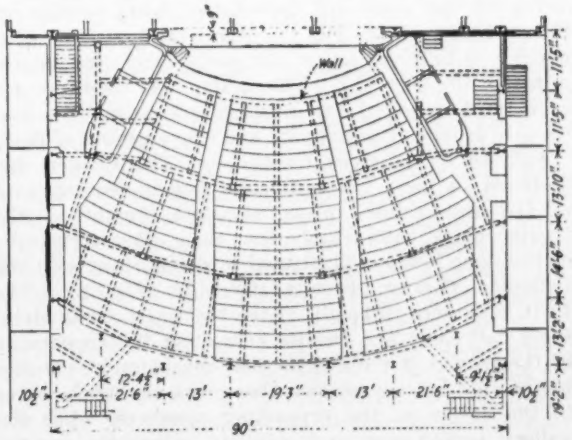


FIG. 4—IRREGULAR FRAMING OF AUDITORIUM FLOOR

to beams framing into two rows of girders and two walls concentric with respect to the seat tiers, Fig. 4. The beams are radial with respect to the seat tiers. The girders take a peculiar type of loading consisting of one beam reaction at the mid-point one side of the girder and two beam reactions at approximately the third-points on the other side. This special arrangement is caused by the seating area narrowing toward the

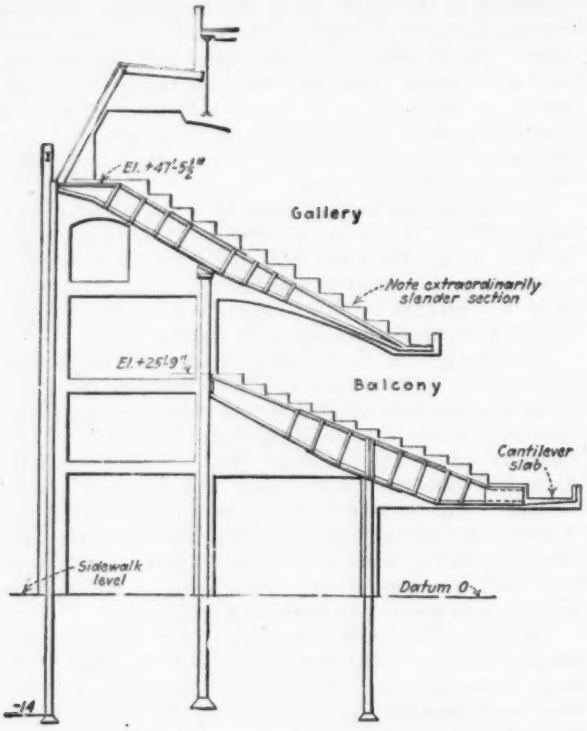


FIG. 5—FRAMING IN VERTICAL SECTION

stage, the panels becoming less wide and one beam being eliminated in each panel between successive arcs of concentric girders. The beams are 10 x 20 in., the girders 14 x 28 in.

There are two other general types of design for floor support, both of which possess inherent disadvantages for the auditorium floor construction. A plain rectangular beam and girder layout was impracticable owing to the slope and the dished floor, because of the necessity of placing the beams and girders in a number of different levels and sloping them irregularly to match the floor slab. This design was therefore not considered and a flat slab construction was not practical because of lack of uniformity and heavy coning of floor.

Balcony and Gallery Cantilevers—The theater was designed to meet the restrictive height requirements of the architectural plans, the total height of the theater being considerably less than other structures of the same kind, as illustrated by comparison with the Columbia Theater, directly alongside (Fig. 2). The 13-ft. difference in height of the two buildings is strikingly noticeable and besides enhancing the appearance of the theater it reduced its cost considerably. Owing to the thin balcony section there was not much choice in the design of the supporting members, while the gallery section was so slender as to require unusual cantilever girders to transfer the loads to columns in the rear of the balcony without supporting columns in the seating area to obstruct vision (Fig. 5).

The gallery which is 90 ft. wide and 45 ft. deep along the center line, was designed for a total load of 170 lb. per square foot (95 lb. dead load and 75 lb. live load). Seventeen longitudinal cantilever plate girders spaced 4 ft. 4 in. carry this load to transverse plate girders supported by eight columns in the outside wall of the lobby. These girders have long arms of from 38 ft. to 26 ft. and short arms of approximately 18 ft., making total lengths of 56 ft. to 44 ft. They are peculiarly shaped for complete concealment within the section of the gallery necessitating breaking the flanges at several points. The heaviest girder has ½-in. web with flanges of two 4 x 3 x ⅜-in. angles and three ⅜-in. plates and stiffeners of 4 x 3 x ⅜-in. angles spaced 3½ ft. over the greater part of the length. The inclined bases which seat these special girders upon the transverse girders or the columns are built up of angles and plates, no castings being used. At the fulcrum the vertical depth of the girders is about 5 ft., which depth decreases to 5 in. at the ends of the long arm. Over the support special stiffening of two 4 x 4 x ½-in. angles is provided. The long arms of the girders are braced transversely by 4 x 4 x ⅜-in. angles.

A cantilever slab varying from 7 in. to 3½ in. in thickness, extending out 4 ft. 3 in., carries the transverse aisle at the rail; the reinforcement is ⅜-in. square bars spaced 4 in. on centers.

The gallery girders averaged about 5 tons in weight and were built up in the shop and set in place complete.

Meeting the same requirements the balcony girders had the advantage of a floor depth considerably more than the depth of the gallery section, which simplified the design of the cantilevers. There are six girders, seated either upon transverse girders or directly upon a row of columns in the front wall of the lobby into which the transverse girders are framed. The balcony members averaged 2 tons more in weight per girder than the gallery members, or about 7 tons apiece. In one case, where the balcony section is deeper than usual owing to architectural arrangements, a truss is used instead of a plate girder.

Balancing the loads on the long arms, the short arms are anchored by attaching them to columns supporting the gallery girders. In this way these columns are relieved from some of their load by the uplift effect. Fig. 5 shows how the gallery and balcony cantilever girder and support systems are inter-related and the loading is transferred to the three parallel rows of columns,

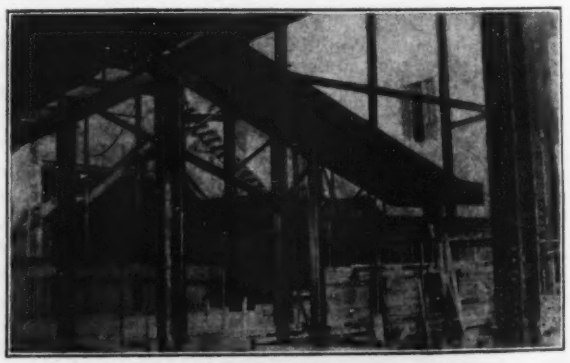


FIG. 6—TWO OF THE SPECIAL BALCONY GIRDERS

the balcony load relieving the columns supporting the gallery, the gallery load in turn relieving the exterior columns in the front wall.

Estimated to have cost $1,000,000, the theater required a little over a year to construct. The architect was Alfred Henry Jacobs; the consulting engineer, W. W. Breite; and the contractor, Ira Coburn, all of San Francisco. The writer was associated with Mr. Breite in the design of the structure.

A Review of the Grand Trunk Railway Arbitration

The Post-War Difficulties of the Canadian Railways, and the Methods Used in the Valuation of the Grand Trunk System for Purchase by the Government

By J. P. Newell
Consulting Engineer, Portland, Ore.

RAILROAD valuation in Canada, as hitherto conducted, presents a different phase from similar work in the United States. There has been no valuation for rate-making, but the stocks of two of the principal companies have been taken over by the government, the price being fixed by arbitration. The Canadian Northern had a book value of $500,000,000, and the Grand Trunk, including the Grand Trunk Pacific, of over $600,000,000, so that property nominally worth more than a billion dollars has been submitted to arbitration in these two cases. The awards were comparatively small, but in their determination it was necessary to take account of the value of the entire property in which the stock represented an equity. Before taking up the engineering features of this work, there should be an understanding of the situation in general.

Canadian Railroad Development—A controlling factor in the railroad development of Canada has been the division of the country by political and topographical barriers into four distinct parts. Ontario and Quebec, with more than half the population and wealth, occupy the central position. The state of Maine thrusts itself far to the north between them and the maritime provinces. On the west a barren wilderness five hundred miles in extent must be crossed to reach the prairie provinces, while two hundred miles of rugged mountain ranges lie between these and British Columbia.

Were it not for the artificial obstacle of a national boundary, each of these sections would find its markets and sources of supply, to a large extent, in the territory to the south of it. In order that Canada might become a united nation it was necessary to overcome this tendency and to link these separated parts by lines of communication wholly within the national boundaries. Such a development was not possible except by government aid and this aid has been freely extended. Subsidies, on a mileage basis, have been generously paid. Land grants were given to Western roads. Interest on bonds was guaranteed by both national and provincial governments, and in emergencies loans or gifts of cash were made.

As a consequence of this liberal policy the railroads of the country have grown faster than the population they serve. Three great systems, the Canadian Pacific, the Canadian Northern, and the Grand Trunk, stretch from ocean to ocean. There has been much unnecessary duplication. For 150 miles two lines cross and re-cross each other in the canyon of the Fraser. From Edmonton to the headwaters of the Fraser two lines were built across the Rocky Mountains, nowhere more than ten miles apart. Three lines cross the vast wilderness north of Lake Superior, where there is practically no local traffic, nor prospect of any. The total mileage, in proportion to population, is twice that of the United States.

The Canadian Northern—Under the stress of war the weakness of the railroad structure soon became apparent. The Canadian Northern was the first of the large systems to give way. The strain of its recent expansion into a transcontinental line was too much for its financial strength, in spite of the profitable operation of its lines in the prairie provinces. Notwithstanding aid was freely given by the Dominion government during the early years of the war, 1917 found it unable to carry on. Parliament, fearing the effect of the bankruptcy of so great a corporation on the morale of a nation engaged in a desperate struggle, authorized the taking over by the Crown of the remainder of the stock of the company, a part having already been taken as security for loans. The price was fixed by arbitration at $10,800,000, or 18 per cent of par, but the proceedings were necessarily hurried, and little was brought out that would be of interest to engineers.

The Grand Trunk—The Grand Trunk was the first of the Canadian railroads. Chartered in 1851 and occupying the richest part of Canada, it maintained its supremacy by absorbing all competitors, but in so doing acquired much unproductive mileage and many duplicate lines. The stock was nearly all held in England and was always highly speculative. The shareholders insisted on all receipts in excess of expenses being at once paid out in dividends and permitted no reserves or surplus to be accumulated. The results of this hand-to-mouth policy and long-distance control are plainly apparent in Grand Trunk history. Probably it was because of the benumbing effect of such conditions that the Grand Trunk made no effort to secure the control of any part of the vast traffic which the Canadian Pacific and the Canadian Northern were building up in the prairie provinces between 1890 and 1900. They also pushed into Grand Trunk territory, reaching the more important cities and usually managing to obtain better access to industries and business than the earlier line. It was the Grand Trunk theory that business should come to the railroad. If a town was difficult of access they laid their line at a distance and served it with a spur track. The other companies believed that the railroad should seek the business, so they built into the towns which the older system had neglected.

In 1903 the Grand Trunk board, after some previous investigations, decided that it would be necessary for the Grand Trunk Ry. to construct its own lines into the Northwest in order to maintain its position, and, as a result, obtained a charter for the construction of a line from Winnipeg to the Pacific Coast under the name of the Grand Trunk Pacific Ry. and entered into an agreement with the government for the operation of a line to be constructed by the government from Winnipeg via Quebec to Moncton. This latter line was built by the government, but the original estimates of cost were so greatly exceeded that the Grand Trunk Pacific Ry. Co. refused to carry out its agreement with the government to operate the road. The government did not take any legal steps to compel the company to fulfill its obligations, but has since operated this road itself under the name of the National Transcontinental.

The Grand Trunk Pacific proved much more costly

than was expected. It was built to standards of grade and alignment suitable for the New York Central or the Pennsylvania. It reached scarcely a foot of territory not already served in Manitoba and but little in Saskatchewan and Alberta. Even before it was officially declared open for operation, the Grand Trunk Co. which held the entire stock and which had guaranteed its bonds to the extent of about $100,000,000, declared it "impossible for them to meet the extra liabilities arising from the Grand Trunk Pacific Co." This was in December, 1915. The management proposed that in return for the stock the government should relieve them of all responsibility as guarantors and repay them for all money advanced to the Grand Trunk Pacific Co.

This the government did not agree to but made several advances to the railway company for the purpose of tiding it over the period of stress. Finally in 1919, a receiver was appointed, and the obligations of the Grand Trunk with respect to the Grand Trunk Pacific were met by the government, the Grand Trunk Ry. being to that extent in debt to the government.

The Post-War Problem—With this assistance the Grand Trunk managed to survive the war, but the enormous increase in operating expenses and the falling off in traffic following the armistice were more than their finances would endure. The government found itself confronted with a perplexing problem. Securities of the Grand Trunk, Grand Trunk Pacific and allied companies which it had purchased or payment of which it had guaranteed amounted to over $100,000,000, while provincial governments were similarly involved to the extent of about $13,000,000.

The bankruptcy of the Grand Trunk Co. meant the loss of practically the entire amount, and would have resulted in the disintegration of the system into numerous small companies which was not considered desirable if it could be avoided.

On the other hand, the taking over of the property meant the assumption of an immense load of debt and the expenditure of vast sums in order to put the lines into proper shape. All this must be added to the already staggering burden of the Canadian National Ry. System, composed of the Intercolonial, the Transcontinental and the Canadian Northern, whose operating deficit in 1919 was $40,000,000, with an interest charge of $30,000,000. As against this, the Grand Trunk lines would furnish the national system with much needed connections with southern Ontario and its many manufacturing cities, and especially with the Niagara frontier, across which moves the greater part of Canada's coal supply.

The Government Authorized to Purchase—Moved by these considerations and influenced no doubt by the desire of a considerable faction for government ownership of all railways, Parliament decided to authorize the government to enter into an agreement with the Grand Trunk Ry. Co. for the control of the stock of that company, which carried with it ownership of all the western lines. An act was accordingly passed in November, 1919, authorizing the government to enter into an agreement with the shareholders for the acquisition of the stock, the price to be determined by arbitration. The agreement, as subsequently made, provided for the purchase of £12,500,000 of guaranteed stock at par, by the payment thereon, in perpetuity, of 4 per cent dividends, and for arbitration as to the value of the preference and common stocks, of £37,000,000 par value. The award was limited to $64,000,000 and it was provided that payment should be in the form of a 4 per cent annual dividend. The holders of £32,000,000 of debenture stock were guaranteed the interest thereon, "as and when payable, in accordance with the terms thereof."

Compliance with the necessary legal formalities delayed the final acceptance of the agreement by the shareholders and approval by Parliament until May, 1920, but as agreement on some terms was assured, both parties went ahead with their preparations. The shareholders employed J. B. Berry, of Chicago, formerly chief engineer of the Union Pacific, who began the preparation, in the fall of 1919, of an estimate of the cost of reproduction at current prices. H. H. Vaughan of Toronto was engaged as mechanical engineer.

The government selected W. N. Tilley of Toronto as chief counsel. Associated with him were Pierce Butler, of St. Paul, H. A. Lovett and J. C. H. Dussault of Montreal, Hector McInnes of Halifax, N. S., and E. F. Newcombe of Ottawa. R. A. C. Henry, of Ottawa, was appointed engineer-in-charge; J. G. Sullivan of Winnipeg, C. S. Gzowski, assistant to the president of the Canadian National Ry., and the writer, were employed as consulting engineers.

The act authorizing the purchase designated Sir Walter Cassels, Judge of the Exchequer Court, as chairman of the arbitration. The government selected Sir Thomas White, Minister of Finance during the war, and the shareholders chose the Hon. William H. Taft, now Chief Justice of the United States. The selection of the arbitrators was not completed until July, 1920.

Theory of the Case—The first problem confronting the government staff was the relation of cost of reproduction to value. It was the unanimous opinion of the engineers that in this particular case neither original cost nor cost of reproduction should be considered, but only earning power. Government counsel approved this view, but advised that inasmuch as it was expected that the company would rely largely on the cost-of-reproduction theory, preparation should be made for defence along that line. Field engineers were accordingly instructed to take their notes with sufficient completeness to enable the office force to make a fairly close check on reproduction cost, if it should prove necessary.

Inspection—Apart from the records of past earnings and expense, it was believed that the most pertinent evidence as to future earning power was to be found in the condition of the property, the amount of deferred maintenance, and the necessary expenditures in the near future for betterments. It was therefore determined to make a thorough inspection of the property. The work was divided into sections as follows: bridges, buildings, docks and wharves, elevators, roadway, grading, land, equipment, floating equipment, signals, electrical equipment. The inspection of grading and land was confined to selected portions of the property for the purpose of checking estimates which might be presented by the company. All other sections covered the entire property.

The inspecting engineers were instructed as follows:

> The inspection of all the properties of the Grand Trunk Ry. System is to be such that with the additional information which will be obtained from the records it will be possible to calculate:
>
> (a) the depreciation, or loss in service-life, of each class of items,

(b) the amount of money which it would be necessary to spend this year on repairs if the property were to be brought into good condition,

(c) the amount of money which ought to be spent this year and each of the next five years for renewals,

(d) the amount of betterments which should be added immediately, and in the next five years, dividing these items into two classes as follows:

(1) those which will increase net earnings, either by reducing operating expenses or by increasing business,

(2) those which will not materially increase net earnings but are made necessary by public demand or competition.

The inspecting engineer must take care that the report on each item of property covers the above four points, presenting either a completed estimate, or such information that the record can be completed and the estimate made in the office.

Besides ascertaining the condition of the property, it is the intention to obtain sufficient information to be able to criticize, if necessary, any physical valuation that may be made by the Grand Trunk Ry. Co.

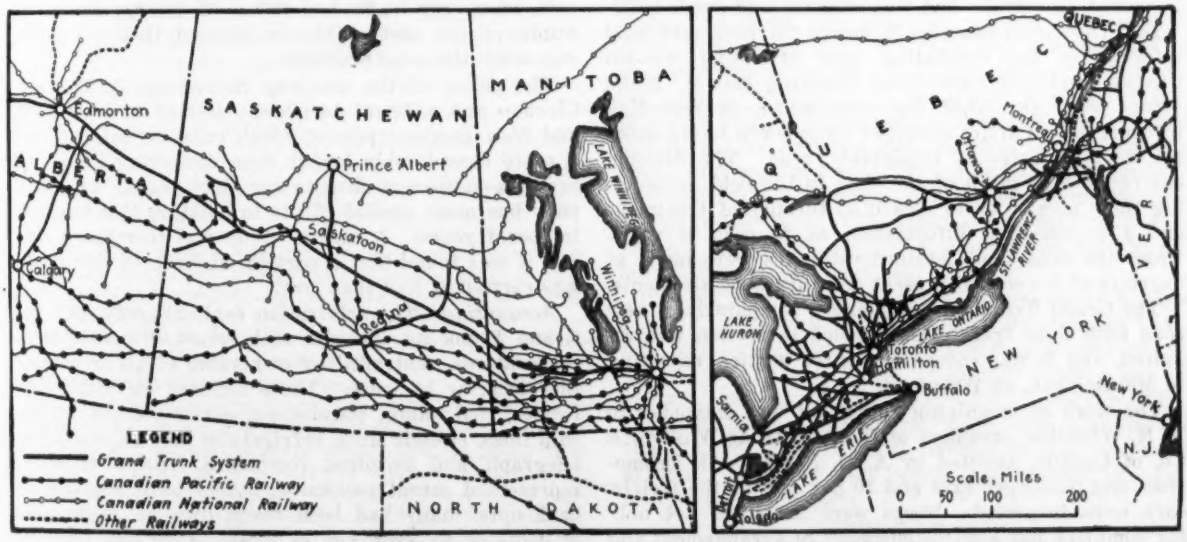
The field engineers were advised that they were not to be unduly critical, but were expected to make such reports and recommendations as would be desired by a management wishing to put the property in thoroughly good working condition. The information collected was intended for use in future operation as well as for the arbitration.

In addition to estimating current repairs and the renewals required within five years, estimates were made of the loss of service-life or depreciated condition per cent, of all plants not yet ready for retirement. This was done in the usual manner, except in the case of rail, the treatment of which has been made the subject of a separate article. (*Engineering News-Record*, Aug. 24, 1922, p. 310.)

The bridge inspection was directed by Col. C. N. Monsarrat, formerly chief engineer of the Quebec Bridge, assisted by P. L. Pratley. The field engineers were instructed to make complete records as to character and general dimensions of structures unless fully shown by plans, to note damage or settlement in substructures, corrosion or injury to spans, condition of

THE RAILWAY SYSTEMS OF CANADA

On this general map will be seen the duplication of railway lines between Alberta and British Columbia, the unnecessary lines through the wilderness north of Lake Superior and the large mileage of Canadian railways, now government-owned, in the United States. The total mileage in proportion to population is twice that of the United States.



ENLARGED MAP OF THE RAILWAY SYSTEMS OF WESTERN CANADA AND LOWER ONTARIO

This enlarged detail shows the network of lines in Manitoba and Saskatchewan, nearly all of which were built before the Grand Trunk Pacific entered the field. Although the Grand Trunk had fully occupied this field of Lower Ontario, it was unable to prevent the entrance of competing lines which have taken away much of its business.

painting and any repairs necessary. In case of temporary bridges they were required to obtain all information necessary for estimating approximate cost of permanent construction. The various parts of the system were classified in accordance with traffic, in three classes. Bridges on first-class lines were investigated for two Mikado engines with a following load of 4,500 lb. per lineal foot of track. Those on second-class lines for Cooper's E45, and on third class for Cooper's E35. If in good physical condition, bridges were considered satisfactory when the unit stresses with allowance for impact under the above test did not exceed 75 per cent of the elastic limit of the material used in the construction. Otherwise, estimates were made for their replacements.

Roadway inspection on the Grand Trunk was put in charge of F. W. Cooper, for the territory east of Toronto, and M. A. Fullington, for lines west. Each had from three to five parties in the field for about five months. Each party was composed of an engineer, a recorder (usually a McGill University student), a conductor, who was responsible for the motor car used for the transportation, and a car runner. They were required to inspect for slides, settlement, scour, insufficient clearance, loose rocks, or other defects of the roadbed, and general conditions of culverts, wooden bridges, fences and all minor structures. Tie-counts were made at intervals of about a mile and notes taken of condition of rail and ballast. The roadway parties inspected also water and fuel stations and small buildings. They were expected to obtain the necessary local information for estimating cost of filling wooden trestles, replacing culverts or renewing ballast. Blank forms were furnished for convenience in recording information. Parties averaged from seven to ten miles per day, exclusive of important yards. The division engineers were much of the time in the field, instructing their men so as to secure uniformity of treatment and also collecting information as to cost of work. From the data thus obtained estimates were made at quarters of the cost of present and future requirements.

The Grand Trunk Pacific being a comparatively new road with light traffic, less detailed inspection was required, and it was covered by three parties, reporting to Mr. Sullivan, at Winnipeg.

The work of examining equipment was entrusted to A. N. Wheatley, president of the Armstrong-Whitworth Co. of Canada, assisted by A. D. Porter. All locomotives and passenger cars and 10 per cent of the freight cars were inspected. Shops were examined not only for condition but also for efficiency of arrangement and location.

Several engineers were employed on large buildings, elevators, docks and wharves, signals and electrical equipment and a naval architect on floating equipment. Their instructions were similar to those already quoted. Special studies were made of impending grade separations in Chicago, South Bend, Detroit, London, Hamilton, Toronto and Montreal; and of the need of additional yard facilities and rearrangement of divisions.

Traffic—Investigations of conditions affecting traffic were conducted by Geo. O. Somers, formerly general freight agent of the Great Northern. The Grand Trunk territory originally produced a large amount of lumber. After the timber was cleared off, agricultural products furnished a bulky traffic. This has now been superseded to a very great extent by dairy products, which bring comparatively little revenue to the carriers. At the same time manufacturing has increased enormously, with corresponding effect on traffic originating in the cities.

Water competition has always exerted a powerful influence on Grand Trunk earnings. From Quebec to Toronto the road parallels the St. Lawrence River and Lake Ontario. The lower Ontario peninsula is reached on all sides by lake transportation. The completion of the new Welland ship canal and the possible construction of the St. Lawrence ship canal will further intensify this competition.

Other factors studied were: The facilities of the Grand Trunk for serving industries, as compared with its competitors; the extent to which it originates its traffic; the effects of competition by automobiles and electric railways; the empty car movement; the railroad development per square mile in Grand Trunk territory as compared to a similar area immediately adjacent in the United States; the effect of the national boundary line, crossed at seven places, in restricting traffic; the degree to which Canadian rates are controlled by American; the effect of water-power development on the demand for coal; abnormal conditions caused by the war and the extent to which they are likely to be permanent.

An interesting disclosure was that while Grand Trunk freight business had increased at a moderate rate, passenger traffic had fallen off for several years. Study of the cost of service showed that the latter was much the more profitable.

The policy of the company in seeking traffic from Chicago and adjacent territory destined to New York and New England points, which must be carried over a route considerably longer than competing lines, had been the subject of dispute for sixty years. The company has made special efforts to build up this business in recent years. A careful study was therefore made, and it was found that a portion, at least, of this traffic was carried at less than cost.

Accounting—The arbitration dealt not only with the Grand Trunk Ry. but also with seventy-five subsidiary corporations, controlled by ownership of all or part of the stock, or by lease. These included elevators, carferries, coal mines, warehouses, express, docks, steamship lines, electric lines, refrigerator service, townsites, telegraph and terminal companies. Some of these represented actual purchases, others were acquired as bankrupts, many had been taken over on assumption of debts or by exchange of stock. Real cost was impossible of ascertainment.

Some had been unprofitable from the beginning; most of them had dropped "into the red" in recent years. Various devices had been employed in order to keep up a favorable financial showing. New lines were kept "under construction" as long as possible so that interest might be charged to construction instead of income. Loans were made to subsidiaries and immediately returned in the form of payments of interest, which were credited to earnings. The process of unraveling all these transactions and presenting them in a form that would fairly represent the earning power of the property was exceedingly complicated. Guaranteed, preference and common stocks and government and provincial guarantees, with varying degrees of precedence, added to the difficulty.

The accounting work was directed by D. E. Brown, formerly assistant director of accounts of the United States Railroad Administration.

The Hearing—It had been originally expected that the hearing would begin in September and be completed by the end of the year, but various delays occurred and it was not until Feb. 1, 1921, that the hearing was begun. After some preliminary testimony, the shareholders' attorneys offered their evidence on the cost of reproduction, but it was at once objected that such evidence was not admissible in a case of this nature. After prolonged argument and consideration, the arbitration board sustained the objection, but with Mr. Taft dissenting.

The importance of this decision as a precedent in valuation justifies an attempt to abstract the opinions, which are too long for presentation in full. Briefly, Judge Cassels and Sir Thomas White held that earning-power was the sole factor in determining value for purchase; that there was nothing before them to show that the board of railway commissioners, in fixing rates, was obliged to consider the reproduction value of railway property nor that the board had ever laid down the principle that such value has any bearing on the question of Canadian railway rates; that even if such principle were adopted, evidence of the reproduction value of one railway would not be useful without similar information as to all competitors; that the same reasoning would apply in the case of the American lines to the cost of one road without that of all others in the same group, as provided by the Transportation Act. They therefore considered the effect of cost of reproduction upon future rates as too remote and indefinite to be taken into account in this case.

Mr. Taft, while agreeing that earning capacity, present and potential, is the basis of value, dissented strongly from the conclusions of his colleagues. His position is indicated by the following excerpts:

> Even if we assume that the company may charge what it pleases and is only affected by competition we may properly assume that in the long run the rates which it charges will have a tendency to produce a net reasonable return on the investment necessary to reproduce at the time of enquiry, a railroad which would do the work to be done for the public with efficiency and economy. . . . Experience has led to the appointment of public utility commissions to regulate and to fix such rates. There is such a board in Canada, and we can properly assume that in fixing these rates in the future the Canadian commission will grant rates that will secure a fair return on the amount of capital needed to reproduce the railway doing the work efficiently and economically. . . . The rule of fair return on necessary value invested is the rule of the government of the United States. . . . Congress, therefore, passed a law which adopted specially the principle that the public service rendered by railways should be compensated for by rates which shall secure a fair return upon the railway property used in the service of transportation under honest, efficient and economical management. . . . This is to fix the rates according to the average physical value of the existing railways engaged in service, which is only an alternative method of determining the amount of capital to reproduce a railway which could render the service efficiently and economically, assuming that the average value of all railways engaged in the service would be the cost of such a new railway. . . .
>
> It would seem to be fair to admit into evidence that reproduction cost of the railway upon the basis of which the future return to the purchaser may fairly be determined, and in all probability will be determined. . . .
>
> The government can meet the evidence, if disputable, by showing lack of economy and efficiency in the present railway, or the one proposed to be reproduced, by showing original bad planning, or any other defect affecting its usefulness as a net revenue producing instrument and by proof of the great amount of additional expenditure on changes needed to render it effective and economical.

The majority necessarily prevailed, and evidence of cost of reproduction was rejected. Although professing themselves greatly disconcerted by this unexpected ruling, the company's attorneys proceeded with the case and introduced a mass of testimony as to the condition of the property and of opinions as to future prospects.

The appointed time for the completion of the arbitration expired on April 9, and the government refused to extend the time unless the company would grant immediate possession. The proceedings were suspended but the shareholders finally yielded the point and the hearing was resumed on June 1. The company completed the presentation of testimony on June 7. During this time the government staff had collected a vast amount of evidence. It then became the duty of counsel to select what was best suited for their purpose and to secure its presentation in the most forceful manner. The approach of hot weather made it desirable to shorten the proceedings as much as possible.

On account of the rejection of evidence as to cost of reproduction, all showing of depreciation was eliminated from the case. The government engineers had found the rolling stock and mechanical equipment in fair to good condition, and no testimony was therefore introduced along this line, the company's statements being allowed to pass unchallenged. Statements of past earnings, expenses and income, testimony as to the condition of the property, estimates of extraordinary expenses and of additional investment required now and in the near future, and opinions as to the future traffic and cost of operation formed the substance of the case for the Crown. Twelve days were required for its presentation. The argument covered eight days, and the case ended on July 8, seventy-one days having been spent in the actual hearing.

The decision of the arbitrators was rendered on Sept. 8, 1921. Sir Walter Cassels and Sir Thomas White held that the preference and common shares had no value. Mr. Taft dissented from this opinion and appraised these shares at $48,000,000. The verdict not being unanimous, the shareholders were permitted to appeal to the Privy Council, but the council, on July 28 of 1922, dismissed the appeal and upheld the decision of the arbitrators.

200-Century-Old Stumps Dug Up in Washington

Steam shovels excavating for foundations for the Walker Hotel on Connecticut Ave., Washington, D. C., have unearthed stumps and logs of trees neither decayed nor fossilized which scientific investigators assert to be at least 20,000 years old, says a recent bulletin issued by the National Lumber Manufacturers Association. The fiber of the wood is well preserved and easily recognizable as cypress. Both sapwood and heartwood are preserved and in some cases even the bark. Dr. G. W. Stephenson, chief of the Section of Coastal Plains Investigation of the U. S. Geological Survey, and C. K. Wentworth, of the same bureau, made examinations of the fossils and gave it as their opinion that they were at least 20,000 years old, and probably belonged to the Pleistocene age.

Some New Ideas on Concrete Design and Construction

Abstracts of Four of the Papers Presented at the Nineteenth Annual Convention of the American Concrete Institute, Cincinnati, Jan. 22-25

Inundation Methods of Measuring Sand in Making Concrete

By G. A. Smith and W. A. Slater
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IT is with the purpose of developing the principles of a proposed method of accurate field measurement of sand and of water for concrete that the investigation reported in this paper was undertaken. The method proposed is based upon the belief that one of the important causes of variability in the strength of concrete is the variation in the quantities of sand and water introduced into successive batches of concrete, even when care is exercised in the measurements. Sand when measured by volume in either a loose or a compacted condition may show great variation in volume for a given weight of sand, depending upon the quantity of moisture in the sand. In one case the volume of the sand when moist was found to be 49.7 per cent greater than the volume of the same quantity of the same sand when dry. A concrete using that sand and designed to be mixed in the proportions of 1, 2 and 4 of dry materials would in reality be mixed in the proportions, 1, 1⅛ and 4 if the sand were measured in a moist condition such as that reported in the paper referred to. Although the figures given indicate a richer mix when the sand is used in a moist condition no advantage in strength is derived therefrom unless the quantity of water used in the batch is reduced for the richer mix. On the contrary, the probability is that if the same quantity of water per batch is added for the moist sand as for the dry sand the increase in the ratio of the water to the cement (due to the moisture content of the sand) will result in a decrease in the strength of approximately 15 per cent. At the same time the cost of the cement for a cu.yd. of concrete will be increased by about 15 per cent, perhaps 65 cents per cu.yd. of concrete with cement at $3 per barrel.

Summary—In considering the applicability of inundation methods of measuring sand, to the making of concrete it should be remembered that such accidental variations in the gradation of the sand as may occur in the field were eliminated in these tests. Other features of the laboratory tests also may not be duplicated in the field. It does not seem likely that such accidental variations need be important but only field application of the method can determine as to its practicability. The following paragraphs summarize the results of the investigation made in the study of the inundation methods.

(1) The results of the tests indicate that when sand is measured in water the quantity of sand per unit of volume is almost constant regardless of the original water content of the sand and that the water filling the voids in the sand is also nearly constant for any given method of placing the sand.

(2) The shoveling of the sand into the water gave more nearly constant quantities of sand and of water per unit of volume than any of the other methods used.

(3) The screening method gave slightly larger quantities of sand and slightly smaller quantities of water per unit volume than did the shoveling method and the results of the tests indicate a lower percentage of air voids for this method of placing the sand than for either the shoveling or the rodding methods.

(4) The rodding of the sand in water gave a larger quantity of sand per unit of volume than any of the other methods used.

(5) Placing the dry sand and the wet sand according to the A. S. T. M. standard C29-21 gave quantities of sand per unit of volume slightly less than when the sand was rodded after shoveling it into the water. The quantity of sand obtained when moist sand was rodded in air was much less than when it was rodded in water.

(6) The inundation method of measurement when used with a predetermined apparent specific gravity may afford a convenient means of determining the proportion of sand to other concrete materials even for jobs on which the materials are being measured by other than the inundation method.

(7) The variation in surface water per cubic foot of coarse aggregate was approximately proportional to the variation in the fineness modulus of the coarse aggregate. The quantity of surface water was considerably greater for the crushed trap rock than for the quartz pebbles. The quantity of surface water averaged about 9 per cent of the total water used in the concretes of these tests or about 8 per cent by volume of the cement. The quantity of absorbed water per cubic foot was greater for the quartz pebbles than for the crushed trap and was independent of the fineness modulus.

(8) For concretes made with quartz sand measured in water the strengths were nearly the same regardless of the condition of the sand, the method of placing it, and the proportion of fine aggregate to coarse aggregate.

The indication is that the measurement of sand by inundation methods should be of assistance in reducing variability of strength of concrete caused by variations in quantities of sand and water in a batch.

The use of a constant water cement ratio for the concrete together with a constant fineness modulus for the mixed aggregate resulted in nearly a constant strength regardless of the proportion of fine to coarse aggregate in the mix.

(9) The use of a constant fineness modulus of the mixed aggregate did not result in a constant slump or flow for the concrete. The variation in each was approximately proportional to the variation in the fineness modulus of the fine aggregate in the mix.

(10) The weight of the concrete per cubic foot and the volume yield of concrete per barrel of cement were practically constant.

How to Minimize Some Defects in Concrete Buildings

By H. D. Loring
Ferro Concrete Construction Co., Cincinnati, Ohio

STRUCTURAL defects in reinforced concrete usually show as cracks; occasionally as disintegration without definite cracks, and less commonly as spalling or buckling. Such defects may be the result of accidents that cannot reasonably be foreseen but many of them can be prevented by proper design and precautions in construction. We are concerned here more particularly with those that can be corrected in the drafting room.

Many structures are injured or rendered unsightly by cracks due to the applied loads for which they are supposedly designed. Walls to retain earth or water are frequently designed as vertical cantilevers, and such walls seldom give trouble, when they are straight. When, however, two such walls are built at right angles to each other as a continuous structure, a wide crack is very apt to appear near the corner, because each wall bends, under the earth or water pressure, enough to cause rupture, even when considerable amounts of steel are bent around the corners. The rigidity of continuous floor construction is so well fixed in the minds of most building designers that they may not at first thought consider how comparatively limber a cantilever is, but recalling that a cantilever of uniform cross-section, under uniform load, deflects forty-eight times as much as a similar fixed beam with the same span and

load, will give one a measure of the deflection that may be expected in cantilever walls. The simplest and often the best preventive of such cracks is to design the walls as separate structures with a joint near the corners. Where liquids are to be retained this is not practicable and the two walls may be connected by a curved or broken section of considerable radius with liberal horizontal reinforcements extending into each wall far enough to take care of stresses caused by restraint. For low walls a generous fillet in the corner with liberal horizontal reinforcement, may suffice.

Cinder Fills—A frequent trouble in buildings having the roof insulated with a fill of cinders is the buckling of the cement topping placed over this fill to receive the roofing. The topping usually is a thin slab of rather lean mortar and unable to withstand the compressive stresses due to expansion at summer temperature, which will frequently raise large blisters. The resulting ridge and cracks are very destructive to roof coverings and are a frequent source of troublesome leaks. Expansion joints are easily made in the topping with some of the prepared strips of bituminous material sold for the purpose or by leaving wood strips which are removed and the space filled with mastic. Such joints should provide for expansion in all directions at the rate of at least ½ in. for every 50 ft.

Cinder fills often become saturated from rains before topping is laid and the water slowly finds the only way out—through the ceiling, resulting in dampness for many weeks or even months. The cost of fill and topping with the cost of carrying their weight to the foundations may amount to 15c. or 20c. per square foot and at best they do not form as good a foundation for roofing as a solid slab. This leads to the inquiry as to whether they must not be eliminated altogether in many cases. Inasmuch as composition roofing contractors will usually guarantee a dead level roof as readily as a sloping one, filling is not a necessity for forming slopes when it is not desired to pitch the structural slab for this purpose. The best reason for the use of cinder fill is as an insulator to prevent undue condensation on a cold ceiling in winter and excessive heat in the top story in summer. While cinder fills accomplish this result successfully and are desirable in buildings, with thin roof slabs in beam and slab construction, the greater thickness of structural concrete in flat slab construction is in many cases sufficient insulation in itself.

Expansion Joints—The question of expansion joints has been a much discussed one and probably the present tendency is to use them in fewer buildings. We believe they are seldom needed in buildings up to 300 ft. in length. Where they are used careful designing is necessary to prevent their giving trouble, especially from leaking floors, in buildings where wet operations are carried on.

Perhaps the best form of expansion joint is one in which the adjoining parts are independent cantilevers. In one building, 560 ft. long, it was considered advisable to use an expansion joint which was secured by resting the ends of the beams carrying one side on brackets formed on the girders and columns of the other; to form a sliding joint. In this case, however, the frictional resistance developed by the dead load of the construction was sufficient to spall or pull off some of the brackets, rather than permit sliding. In designing such brackets either for expansion joints or to carry future extensions, care should be taken that sliding on the joint will take place before any destructive force may be transmitted to the brackets.

In beams, cracks of the well known shear variety may be caused by forces other than loading; for example, a slight settlement of supports, or of the formwork before the concrete has fully set. These cracks are likely to occur as in shear failures, since the accumulated stresses are greatest at these points. Cracks of this kind can usually be avoided by placing stirrups throughout the beam, not further apart than three-quarter the effective depth, and repairs can be made by cutting out a section of the beam and floor, placing sufficient stirrups and re-concreting.

In many buildings having structural members exposed on the exterior, time and the elements have worked considerable damage by spalling and flaking of concrete and exposing steel to corrosion. Frequently the spalling is occasioned by the swelling of steel which has carroded when reached by moisture, due to insufficient covering; perhaps occasionally aided by electrolytic action. The great preventive of such unfortunate results is sufficient concrete protection for the steel. No such members should be designed with less than 2 in. minimum cover and 3 or 4 in. would often be desirable. Where bars are accidentally exposed during construction, the trouble should be remedied at the time.

The dense surface finishes produced by rubbing in cement grout are a protection to the building as well as an addition to its appearance, while the bush-hammered effects and other finishes which expose aggregate should only be used when ample cover is given to the steel. Repairs to buildings so damaged are difficult and costly, but should not be neglected. The steel should have all loose scale wire-brushed or otherwise removed before pointing is done and every precaution taken to secure a bond for the pointing mortar. Metal lath may sometimes be used to advantage by tying to the reinforcing with galvanized wire. Painting the steel with a bituminous coating before pointing with mortar may prevent further corrosion.

Some building codes encourage the placing of steel too near the surface by specifying that in vertically rodded columns only the concrete inside the ties may be counted to carry load. This appears to be based on an incorrect idea of the use of ties in vertically rodded columns; their function is, of course, only to stay the vertical bars and they cannot add anything to the strength of the concrete in the way that closely spaced spiral hooping does. Such test data as the writer has examined do not show any effect of changing the location of vertical steel in a column, as long as it is symmetrically disposed. In designing columns for bending moment, the position of steel must of course be taken into account.

A Concrete Tank Reinforced With Outer Tightened Bands

By W. S. Hewett
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SHRINKAGE of concrete is a much more important factor in a structure subject to hydraulic pressure than it is in the ordinary structure. This great factor has received but little consideration in existing tanks. In cases where these tanks have been wet until filled and then have been filled, or partially filled, no serious results have followed from shrinkage. But if we examine the history of tanks that have stood for some time before being filled or have been repeatedly emptied and filled the result of shrinkage is apparent.

From my experience and observation and from my study of the experience and observation of others I have formed the opinion that a logical reinforced concrete tank should be designed in accordance with the following principles:

(1) Shrinkage stresses should be kept at a minimum, not over ¼ of 1 per cent of steel should be placed in the concrete.

(2) Concrete should not be in tension.

(3) Concrete should not be subjected to heavy shear on horizontal planes.

I can best outline my methods of construction by taking an example. At Barnum, Minn., we built in 1922 a tank 20 ft. in internal diameter, 32 ft. high and approximately 75,000 gal. capacity. We first made excavations to a depth of about 5 ft. and put in a footing for the side walls. We next built the bottom of the tank which was a slab 15 in. thick, with a diameter of 20 ft. This slab was reinforced with light radial and circular rods top and bottom and rested upon the ground with its outer part resting upon the footings already placed for the side walls. Side walls were then constructed 7½ in. thick, with vertical recesses at intervals 15 in. wide and 1½ in. deep. These recesses were for the accommodation of the turnbuckles for adjusting the steel bands. Each band had three turnbuckles.

The side walls were built in a sectional form 6 ft. 6 in. high, allowing a vertical run of about 6 ft. each day. The construction joints between the day's work were cleaned and washed before the next day's run was started. Forty-eight

⅝-in. round vertical rods, spaced about 16-in. apart, were placed in the wall. There were also three horizontal bands ½-in. round rods placed in each day's run about 24-in. apart, used as a precautionary measure in construction.

The forms for the side walls were adjustable to permit them to be loosened before raising to the new position. The side walls were run in six days. This work was done in late October and during November. Temperature ranged from a few degrees below freezing to about fifty degrees. The water used in mixing concrete was heated but no other precaution taken and no heat was applied to the finished work. As soon as the side walls were complete, the work of assembling the adjustable bands began. These bands were simply placed in position and tightened sufficiently to keep them in place. These bands were each in three pieces, the turnbuckles being spaced 20 ft. 4½ in., 20 ft. 4½ in. and 26 ft. 4½ in. The turnbuckles were not staggered. The rods were of mild steel, with an elastic limit of about 36,000 lb. and a modulus of elasticity of about 24,000,000. They were not upset but were provided with rolled threads. Our computations indicated that an initial stress of about 14,500 lb. per square inch was desired in the rods near the bottom, changing to about 15,000 lb. per square inch higher up.

The rods were assembled in such a manner that the lever used in tightening the rods worked down. Three men were selected, each weighing about 175 lb., and placed at the turnbuckles. Strain gage measurements were made at points on one of the rods and the length of the wrench changed until satisfactory readings resulted. It was found that when tightening a rod 1⅛-in. in diameter, a 15-in. wrench in the hands of a man weighing 175 lb. would give the desired result. This rod was then loosened and the work of adjusting the rods was started at the bottom of the tank. No more readings were taken until all rods were adjusted. Readings taken on the rod referred to above gave an average stress of 14,000 lb. per square inch. This rod was No. 18 from the bottom of the tank. Readings taken on rod No. 53 from the bottom showed an average of 14,560 lb. per square inch. In adjusting, the rod was tapped with a light hammer at points between the turnbuckles. This tapping relieved the brake action and adjusted the rods to the concrete surface with uniform stress. Our measurements indicated but slight difference between the stress near the center of the rod and that near the turnbuckle.

After the rods were adjusted a wire netting covering the entire tank was attached to the rods. The circumference of the outer forms used in molding the side walls was enlarged to permit the placing of 3 in. of concrete outside of the rods and embedding the wire netting. This outer concrete gives a protection to the rods and increases the bearing. Where a gunite plant is available, a coating of gunite 1¼ in. thick would be preferable to the 3-in. placed as above.

After the adjusting of the bands on the lower part of the tank, 9 ft. of water was put in the tank to observe its action on the porous concrete in the lower 6 ft. This concrete, when the forms were removed, showed the rock in many places. When water was put in the tank, the lower 6 ft. section sweated to such an extent that the wall was wet on the outside. Above this, where the richer mix was used, only very slight damp spots were observed on possibly 20 per cent of the surface. None of the construction joints leaked. After allowing the concrete to be thoroughly soaked the water was drawn off and the inside of the tank wall given a brush coat of "Ionite," and followed by a brush coat of 80 per cent cement and 20 per cent "Ionite." Both coats were put on with paint brushes and but very little left on the surface.

The tank was entirely filled before the outer coating of concrete was placed to permit of measuring the ultimate tension in the rods. This ultimate stress measured 16,500 lb. per square inch.

Five per cent of hydrated lime, by bulk, was used in all concrete.

The next day after the tank was completed it was filled to its capacity and left three days for the examination of the engineers. Not the least dampness ever appeared on the outer surface.

Trend of Concrete Road Design

By H. Eltinge Breed
Consulting Engineer, New York City

As far as I can ascertain the influence upon design of considering the relation between the road-bed and the paving slab is likely to develop in two opposite directions. Either we shall pay much more attention to the road-bed, or we shall pay none at all.

Design Road For Subsurface—In the first case, before designing a road at all, the engineers will make a much more thorough study of drainage and subsoil conditions and bearing power of the subgrade. Then we will design, not in terms of miles or even hundreds of feet as we do now, but in terms of slab units, proportioning the strength of each slab to the support it receives from the foundation. Thus, across a stretch of swampy ground the slabs might be designed 9 in. thick with steel reinforcement equal to that of a building floor founded on supports while 200 ft. further on, up the sharp ascent of a hill, the slabs may be only 6 in. thick with slight reinforcement. The high cost of the slabs on unstable soil would be leveled down by the low cost on the firm soil until the average cost of the road would not exceed that of the so-called average road today.

The second tendency is to leave the road-bed out of consideration, and with regard for economy devote our energy to getting a pavement structure that per se will sustain the demands of traffic upon it. This is the line along which Professor Elmer Hooper, of New York University, has been working and he has permitted me to present to you here some of his results. I now quote from him:

A Proposed Precast Road—"The usual percentage of steel is so small that it is readily acknowledged by most engineers to be of little value in load distribution. Its specified purpose is therefore limited to temperature resistance, bond between adjacent units to prevent vertical and horizontal separation, and strengthening of relatively weak local areas such as corners and unsupported edges. Of these only the temperature stresses seem to determinate and at first thought it might appear possible to make calculations to fix the amount of steel to keep intact a predetermined length of slab. It is unfortunate, however, that when stresses develop from temperature change there are very likely to exist at the same time severe stresses from passing loads which, though not causing any increase in the resultant axial stress do cause such a distribution of it as to overburden and rupture those fibers farthest removed from the neutral axis. When the crack starts it has to continue because of the reduced area to resist. Calculations on this basis are therefore of doubtful value. To develop a pavement of positively known qualities it is necessary to make determinate the nature and condition of supports. If and when that condition is established there is no logical reason why a design may not be developed, along the same lines as a bridge or building. It would not be necessary to use such low unit stresses for calculation of a pavement unit since it would not involve serious danger to life and property in the event of failure of a unit.

"Along this line the writer has evolved a plan of design and construction, which has for its purpose to satisfy the conditions just discussed. The point of most importance is that the pavement is made up of units, each supported at three points. The supports are solid and carried below frost. Each support carries the ends of one or more adjacent units. Adjacent edges are designed to interlock to make adjoining slabs mutually supporting. It may be readily seen that with this method of support a slight settlement of one end will cause no appreciable change in designed stresses.

"In the plan proposed the subgrade will carry no load though under excessive deflection there may be contact. There will, therefore, always be a sag between supports, due to dead weight as well as to live-load. The top surface will be always in compression and therefore not subject to cracking, while the bottom will always be in tension. Since the supports may be considered as permanent, the moments and shears for given loads may be calculated.

Foundation and Scour Protection of Large Power Station on Mississippi River

Alluvial Subsoil and Flood Scour Possibilities at Site of Cahokia Station Near East St. Louis Lead to Use of Mat Foundation on Concrete Piles Protected by Concrete Sheet-Pile Cut Off

DIFFICULT foundation conditions, heavy building loading and direct exposure to the attack of the Mississippi River constituted one of the critical problems in the design of the Cahokia Station, a large-capacity steam turbo-generating station on the east bank of the river for the Union Electric Light & Power Co. of St. Louis. McClellan & Junkersfeld, Inc., engineers and constructors of the station, found the solution of the problem in the use of a foundation of reinforced-concrete piles, adopted on the score of strength and permanence. A unique feature is a deep cutoff at the river front, constructed of interlocking concrete sheet-piles of unprecedented size. The station, which is now being built, is represented in its most important features by the cross-section Fig. 1 herewith.

Soil Conditions—The site selected for the station is on a broad plain on the Illinois side of the Mississippi River, about a mile below the center of the city. The station receives its name of Cahokia from this plain and from the first settlement in Illinois, nearby. The soil is a river deposit, as indicated by the topography, and is a fine-grained sand of no value as a foundation material. Rock is at a depth of about 100 ft. or more.

Borings made at the site showed that the fine sand extends about 25 ft. below low water, and that at this depth it merges rather quickly into a stratum of coarse firm gravel, not of recent origin. From this fact, and a careful and thorough investigation of the river records and history, it was concluded that the possible river scour is limited to 30 or 40 ft. and that a sufficient penetration below this level would be proof against scour. The reinforced-concrete bearing piles used for the foundation are jetted and driven to a firm bearing in the gravel stratum and the interlocking concrete sheet-pile wall along the river front extends down to and enters the gravel stratum to give additional protection to the bearing piles should the river bed be lowered by scour.

Station Plan—An ultimate capacity of 240,000 kw. is to be provided for in the Cahokia station. The present installation will be one-fourth of the ultimate, comprising two 30,000-kw. turbo-generators. This first section of the station extends approximately 230 ft. along the river by 235 ft. in depth, and the intake and discharge tunnels and condenser pit for the first two units are all within the building and are located about at the center of the first section. The subsequent sections will be substantially duplicates of this one.

Bearing Piles—A foundation plan of the first section is shown in Fig. 2. As will be seen from the drawing, the piles are grouped and spaced according to the amount and distribution of the loads imposed by the structure and equipment.

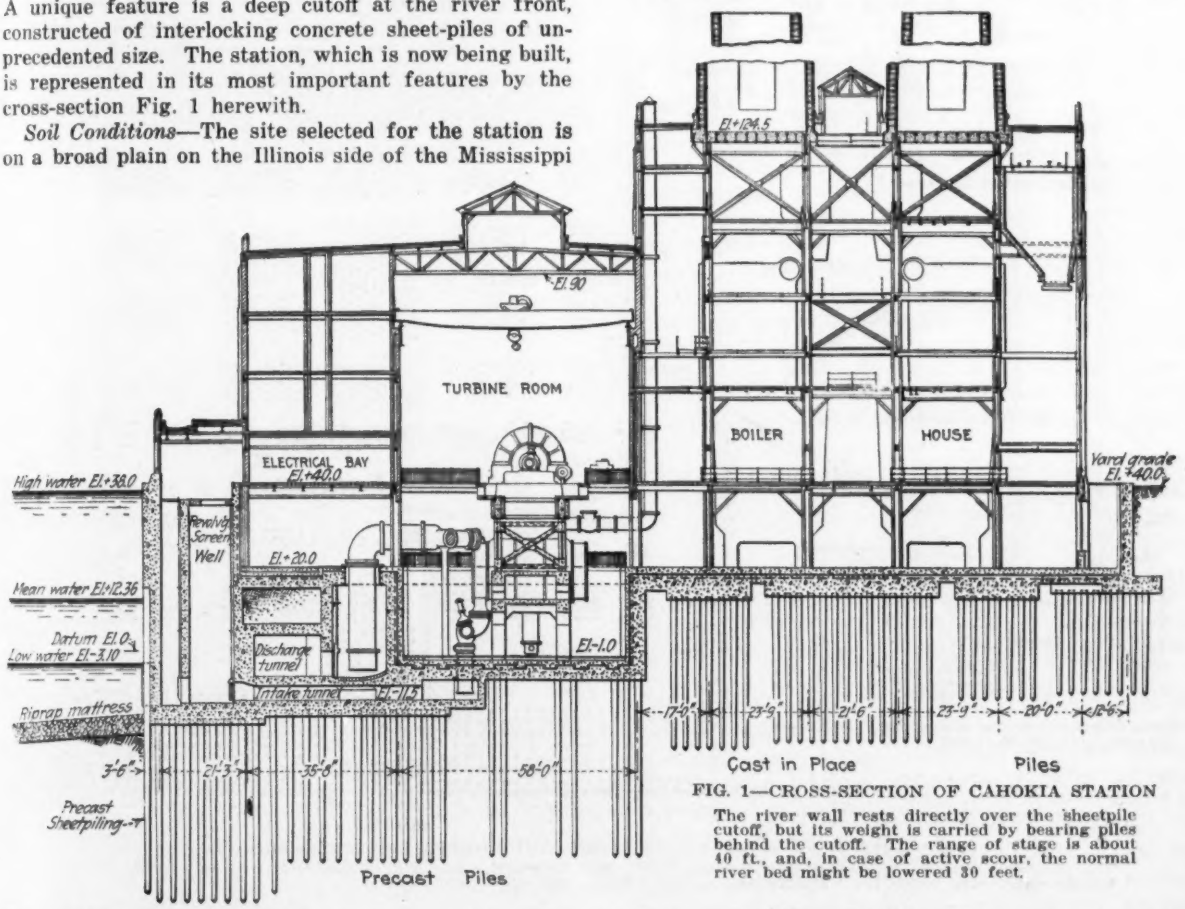


FIG. 1—CROSS-SECTION OF CAHOKIA STATION

The river wall rests directly over the sheetpile cutoff, but its weight is carried by bearing piles behind the cutoff. The range of stage is about 40 ft., and, in case of active scour, the normal river bed might be lowered 30 feet.

The piles in the part of the station nearer the river are precast reinforced-concrete piles 17 in. square at the butt and 40 to 75 ft. long, depending on the driving depth and the cut-off level. The piles are jetted down and finally driven to bearing well into the coarse gravel. In the rear half of the station regular Raymond cast-in-place piles are used, being cheaper and their use being practicable as this part of the site was above water.

River Cut-off Wall—For the river cut-off wall, interlocking concrete sheet piles were adopted. These are 18 x 21 in. in section, rectangular, with integral steel interlocks, and are 75 ft. long; they weigh 15 tons each. They extend from El. +15 to —60, the latter depth being 25 to 35 ft. below the top of the gravel stratum. Above and back of this sheet-pile cut-off is the river wall of the station. The face of the river wall is continuous with the front of the sheet piles but its principal mass is back of the cut-off and rests on the reinforced-concrete mat and bearing piles. The lowest part of this mat is at El. —16, under the intake tunnels, and as the river wall extends up to the level of the turbine floor, El. +40, its maximum height is 56 ft. The wall is bonded to the sheet piles of the cut-off by reinforcing bar dowels. Thus a substantial barrier against river action between the levels of high river stage and deepest scour, a height of about 70 ft., is provided.

Waterproofing of Mats and Walls—The reinforced-concrete mat over the piles is in general 48 in. thick. It is tied to each pile by steel bars engaging the bars in the piles so that the pile weight and its frictional resistance assist in overcoming hydrostatic uplift. To provide against the possibility of water entering the building through the mat and walls a waterproofing membrane of asphalt and fabric is used. Due to the piles entering and being doweled to the mat it was necessary to place this membrane on top of the mat.

Under ordinary methods of construction the concrete surfacing over the waterproofing would have been made of sufficient weight to resist the hydrostatic pressure penetrating through the mat and acting on the bottom of the waterproofing. Under a condition such as obtains in the condenser pit, where at high water there may be a head of 40 ft. acting on the membrane, so great

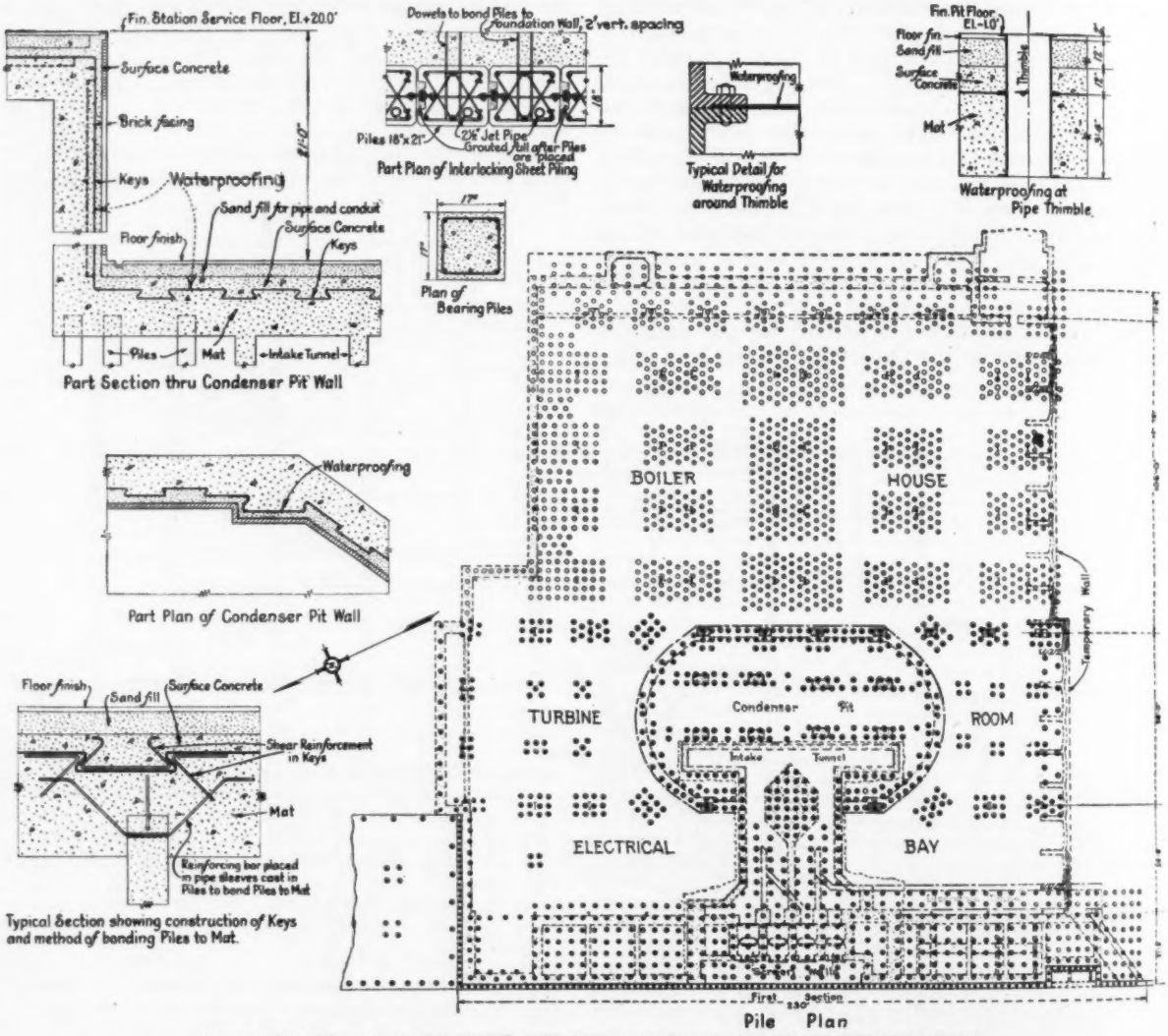


FIG. 2—PILE PLAN, SHEET-PILE CUT-OFF, AND DOVETAILED WATERPROOFING

The surfacing concrete is held to the foundation mat by the dovetails, over which the waterproofing is laid. This avoids the use of a surface course heavy enough to resist the hydrostatic uplift.

a thickness of concrete would have been required that the ingenious expedient of bonding the surfacing concrete and the mat together was devised, thus reducing the thickness of the surfacing concrete by using the weight and strength of the mat plus the piles to resist the upward pressure. The bond is obtained by keying the surfacing concrete to the mat by a dovetail construction, as sketched in a detail in Fig. 2. The dovetails are formed in the mat, the waterproofing is then applied to follow the contours of the dovetails, and

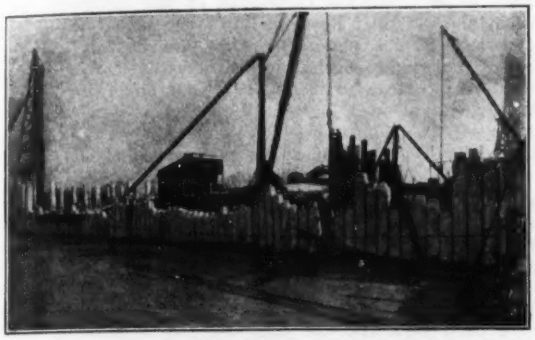


FIG. 3—SHEET-PILE CUT-OFF UNDER CONSTRUCTION

finally the surfacing concrete is poured directly on the waterproofing, thereby completing the keying. The dovetails are substantially reinforced with shear bars and the surfacing concrete between dovetails is designed and reinforced as a slab. A similar construction is used for the walls wherever there is water pressure.

Construction—A pile casting yard was established at the site and the piles were allowed to season not less than 30 days. They were handled from the forms to the seasoning yard and thence to scows by locomotive cranes. A trestle was built projecting into the river to give the crane access to the scows at varying river stages. All of the precast bearing and sheet piles were placed by floating drivers. The piles were lifted from the scows to the leads by special tackle designed for this purpose. In sinking each bearing pile, two jets were used, supplying a large volume of water under high pressure. For the sheet piles the jets were supplemented with a 2-in. pipe cast in each pile. All of this work was done by the Raymond Concrete Pile Co.

In order to provide the necessary draft for the driving barges and to lower the river bottom to the elevation of cut-off of the piles under the lower portions of the mat, it was necessary to do a large amount of dredging. It was also necessary to deposit about 200,000 cu. yd. of hydraulic fill in the form of levees to raise the site to established yard grade. A 20-in. hydraulic dredge was used for this work.

The condenser pit, intake and discharge tunnels and water basins in the river bay, the mats of which are below normal water level, were constructed within cofferdams consisting of timber cribs enclosed with interlocking steel sheet piling. The length of the steel sheet piling was in general about 50 ft. and the piling was driven to bring the tops to El. +15. After the cofferdams were excavated to the proper levels and before they could be unwatered, concrete sealing mats, the tops of which are at the underside of the station mat, were deposited by tremie because the saturated, granular soil could not withstand the unbalanced pressure despite the penetration of the sheet piling. These mats were of a thickness determined to be from 20 to 25 per cent of the head that might be expected during the period of use of the cofferdam. After sufficient time had elapsed for the sealing mats to set (depending on the temperature of the water), the cofferdams were unwatered and the construction of the reinforced-concrete mats and walls was carried on in the dry.

The river and weather conditions have been favorable and no unusual difficulties or setbacks have been encountered thus far. The concrete work, exclusive of the piles, is being done by Fruin-Colnon Co. of St. Louis.

California State Aid Colonization Projects Achieve Success

IRRIGATED lands in California at Durham and Delhi, which were developed and supervised with the aid of state funds, are making a very favorable showing, according to the recently issued report of the Land Settlement Division, California Department of Public Works (Sacramento). During a period of the hardest times ever known to farmers, the report states, settlers on these projects have been able to meet their payments on farms, continue their improvements, and help build up wholesome and successful rural communities.

Both settlements are solvent enterprises. The land in the first settlement at Durham was sold for more than enough to pay for the land and to meet all development expenses. After the state has been paid the principal and interest of its advance, there will remain a surplus profit of $140,000.

The Delhi settlement is still being developed but if the farms continue to sell at prices now fixed there will be a considerable surplus over all state expenses. The increase in population and taxable wealth which is coming to the state from these two ventures has therefore placed no burden on state taxpayers. A total of 356 farmers have established homes in the two settlements, of whom more than one hundred are ex-service men.

Co-operation in buying and selling has been a notable feature of these settlements. Ten per cent has been saved, the report states, on the cost of homes and even more in the purchase of equipment, while the formation of co-operative enterprises for marketing products has enabled producers to command the best prices. Although the irrigation system for Delhi is not completed, settlement has kept pace with this progress. Last year a new house was completed every two days.

The first part of the report contains a statement of the relation of state aided land settlements to the prompt and successful development of irrigation districts and shows the same need for financing settlers that there has been for providing the millions of dollars with which reservoirs and main canals have been constructed.

The fact that there are a million acres of land in existing irrigation districts awaiting settlement is cited as showing this to be one of the most important social and economic problems of the state.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

What a Sales Engineer Does

Sir—Mr. Bedell's letter and your editorial in the Dec. 28 issue of *Engineering News-Record*, objecting to the term "sales manager" and taking the position that there is not and cannot be any such profession due to the inevitable conflict of the ethics of the engineering and selling professions, are open to three main objections: First, the sales engineer is an indispensable factor in industry, has been for years, and the field for his further development is practically unlimited; second, the Pharisaical objection to the term by other engineers is based on a complete misconception—and ignorance—of the principles governing good salesmanship; and third, sales work offers the most comprehensive and profitable solution of the problem facing the engineering profession today—the surplus of trained engineers and the consequent inadequate remuneration and lack of employment. Anything which tends to turn engineers from an outlet offering ideal employment for men of their general type and training, is obstructing the progress of the profession as well as that of the individual members.

The question "what is a sales engineer?" can perhaps be answered best by concrete cases. The two largest manufacturers of electrical apparatus have for years used engineers exclusively on their sales forces. Graduates in electrical or mechanical engineering, these men usually spend two years in the factory and two or more years in the engineering department, specializing on some particular line of apparatus, before they go out on the sales force.

As sales engineers, in touch with the latest developments in engineering and production, keeping up with what their competitors are doing, they can and do give the customer necessary and valuable technical advice; recommending to his engineers the purchase of such apparatus as will best fit his conditions, the scrapping and replacement of obsolete or uneconomical machinery, etc. This may be objected to as the legitimate field of the consulting engineer, but even if it were not a more economical arrangement all around, the progress of the electrical industry has been so rapid that no consulting engineer, not connected with a manufacturing company, could keep up to date. The customers' engineers depend on the sales engineering representatives of the different manufacturers to keep them abreast of the times in engineering development.

In the field, in a position to study the apparatus in operation, the sales engineer appreciates the customers' requirements as well as the manufacturers' and is less an "advocate" and more a "judge" than the design engineer sitting at a desk in the factory; devoted to his own ideas, and influenced, more or less unconsciously, by the manufacturers' point of view. To the writer's personal knowledge, it is common practice for these "unethical" salesmen to demand of the manufacturer, changes the better to meet the customer's requirements, even at a possible expense of manufacturing expediency and profits.

Again, in case of trouble, he is the manufacturer's engineer on the job, the first man called in to help get the machinery in regular operation again. Is there any defensible reason why these men should not retain their right to be designated as engineers? Can any better method of distribution be devised—from the standpoint of manufacturer, salesman or customer?

They are also salesmen in that they actually "book orders" which brings us to the matter of ethics. What is the ethical difference between an engineer who sells his services to a manufacturing company to design and develop products in accordance with the price, quality and trade standards of his employer and the engineer who sells these same products? If the products are such that the salesman can't honestly sell them, how about the ethics governing the engineer who designed them? In practise does the design engineer refuse to design inferior or faulty products as often as the sales engineer refuses to sell them?

Mr. Bedell states that if a salesman should apply "professional ethics"—by which I assume he means plain ordinary honesty—to sales work, he would soon be out of a job. He is most likely to be out of a job if he doesn't. When he has lost the confidence of the customer—which he certainly will, if he gives incorrect or prejudiced technical advice and persuades him into buying something he does not want—he has lost the customer's future business and is of no further value to his employer. That is obvious cold-blooded logic, and neither customer nor employer will take into consideration any imaginary "double standard" of ethics governing engineers and salesmen.

If you happen to know of an engineer who in his complete ignorance of the essentials of selling, is attempting to sell an inferior product by crooked methods, don't blame his fall to his entrance into sales work. "Sharp practise," misrepresentation, hypnotic stunts, have no more place in the sales profession than patent medicine methods have in the medical profession. If a product is so inferior as to require such methods, the engineer should leave it to the so-called "super," "high caliber," "six-cylinder" salesmen. The sooner such products are forced off of the market, the better for everybody, including their manufacturers.

Establishing his position in the sale of machinery to industry, the engineer has only scratched the surface of his opportunities in sales work. All the materials and supplies purchased by industry offer an attractive field for the application of sales engineering methods. Once rid of the fallacy that his engineering training fits him only for a particular branch of the engineering profession in which he has specialized, and awake to the fact that a trained mind can be applied to any work, the whole selling field offers interesting possibilities to the engineer.

To be sure the average engineer will need to cultivate tact, the ability to present his subject clearly and convincingly, to think and act quickly in an emergency, and he must know human nature. But these things are of equal, if less recognized importance, in strictly engineering work. Success as an engineer depends directly on sales ability, the engineer's ability to sell his services to an employer, to put over his engineering projects with capitalist, executive, or the public.

I am afraid I am exceeding my space allowance, but intimate contact, especially since the armistice, with first class engineers, out of work or obliged to maintain their families on inadequate salaries, and the tendency to discourage the younger generation from taking up engineering work in college have emphasized the importance of a realization of the opportunities offered by sales work to the trained mind of the engineer. On the other hand manufacturer and consumer need the engineer in sales work. He can be of invaluable assistance in standardizing and perfecting the product, simplifying and improving the methods of distribution.

These are not opinions but facts as I have found them in sixteen years of engineering, manufacturing and sales work. My associates and myself, a sales organization composed of mechanical, mining and electrical engineers, see no reason for removing "Sales Engineers" from our letterheads. We sell only products which stand strict engineering investigation. We recommend them to our customers when they will meet their requirements, or tell them frankly when they will not. There is nothing altruistic or unusual about our methods—we simply practice good salesmanship.

Speaking for the sales engineers of the country, I make the unreserved statement that the ethics of our profession will stand comparison with the ethics of any other branch of the engineering profession

New York, Jan. 15. HARRY CARLTON.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

News Brevities

The 1923 convention of the National Highway Traffic Association which was to have been held in Cleveland, Ohio, Feb. 19 and 20 **has been postponed.**

The Finance Committee of the Senate and the Ways and Means Committee of the New York Assembly have announced that a hearing on the Webb-Hackett bill, **authorizing a state highway bridge across the Hudson River** at Poughkeepsie, will be conducted Feb. 20.

The 1923 paving program for Akron, Ohio, according to information supplied *Engineering News-Record* by E. A. Kemmler, highways engineer, includes 18.3 miles of paving, 0.70 of repaving, 2.5 of resurfacing, and 12.18 miles of grading and walks. The total estimated cost is $2,950,000, of which $676,000 will fall on the city.

In order to obtain an accurate knowledge of the water power of the Winnipeg and English Rivers 24 government engineers are now engaged in making a geodetic survey. The levels are being taken from Sioux Lookout to Fort Alexander. The engineers will submit their report to the Dominion government in March.

The Rolling Stone bridge over the Susquehanna River at Clearfield, Pa., which was damaged two years ago in an ice jam and was being rebuilt, was further damaged in another jam last week. All work of the last two months was torn out. Damage is estimated at $7,000.

The caisson for the New York river shaft of the Hudson River vehicle tunnel between New York and Jersey City was towed from the yard of the Staten Island Shipbuilding Co., where it was built, to its position at the foot of Canal St. on Jan. 30. The caisson is about 93 x 37 ft. and forms the lower section of one of the shafts by which the tunnel will be ventilated.

Governor Silzer of New Jersey has recommended George Paddock of Newark; Harry D. Werthing, of Orange; and Joseph McDonough of Newark, as the three-man highway commission to replace the eight-man body he recently dissolved. Names of these men will be sent to senate leaders for tentative approval, according to their request.

Four men were killed by the collapse of a two-story brick dwelling house in Pittsburgh on Jan. 22. The house was over 50 years old. A commercial building was being constructed alongside, and foundation work was in progress. It is reported that the footing excavations undermined the side wall of the house and caused the wall to buckle half way up. The men killed were at work on the new footings.

B. F. Cresson, Jr., Port Authority Chief Engineer, Is Dead

Benjamin F. Cresson, Jr., chief engineer for the Port of New York Authority, died Jan. 26 following an operation for appendicitis. He was taken ill in the corridor of the building housing the Port Authority offices two days prior to his death. Mr. Cresson was forty-nine years of age.

Mr. Cresson, who was born in Philadelphia, received his education at Lehigh University and the University of Pennsylvania. After leaving college he served on the engineering forces of the Lehigh Valley R.R. from 1894 to 1897, at which time he was appointed transitman on the construction of the Reading subway in Philadelphia. In 1900 he was made assistant engineer in the office of Jacobs & Davies, consulting engineers, New York City, on preparation of plans, specifications and estimates for the proposed tunnels for the Long Island R.R. under the East River, New York City. In 1901 he was assistant engineer in resurvey plans for the completion of the Hudson tunnels under the North River (McAdoo tunnels). During the next nine years he was assistant engineer, alignment engineer and resident engineer in charge of precise triangulation on the North River, resident engineer in charge of a section of the subaqueous tunnels under the North River, and resident engineer on the Pennsylvania Terminal in New York.

Mr. Cresson was appointed first deputy commissioner of docks of New York City in 1910, during which time he visited Europe to study important harbors. He held that position until early in 1913, when he resigned and was appointed engineer of the New Jersey Harbor Commission. Two years later he was appointed chief engineer of the Board of Commerce and Navigation of the State of New Jersey. He held that position two years, after which he resigned to enter consulting practice in New York City.

In his consulting practice Mr. Cresson served the Board of Harbor Commissioners of Wilmington, Del., Pacific Port Terminals, San Francisco, City of San Diego, Cal., Port of Tampa, Fla., and the Board of Harbor Commissioners of Camden, N. J.

He became associated with the investigation of the engineering features of New York harbor at the time of the formation of the interstate body which preceded the organization of the Port Authority and was responsible for the major part of the engineering plan made by that body and incorporated in the interstate treaty. He became chief engineer of the Port of New York Authority at its formation.

Concrete Institute Meets in Cincinnati

Program Covers Construction and Design Problems and Study of Concrete Products

Engineering News-Record Staff Report

A growing interest in the concrete products industry was the distinguishing feature of the nineteenth annual convention of the American Concrete Institute, which was held at Cincinnati, Ohio, Jan. 22-25. In the early days of the Institute, then the National Association of Cement Users, the so-called cement block was very much in evidence, but as that product declined in quality and quantity interest in the society likewise declined. Now, however, when a different sort of individual is in the concrete products business and he is producing a quite different sort of product, the Institute has recognized the growing necessity to provide a forum for debate and a medium of standardization for the various precast concrete activities. Two or three of the sessions, therefore, were devoted to committee reports discussing concrete blocks, brick, and tile, and to the business of concrete products manufacture. While the major part of the proceedings was devoted as usual to the structural field, the recrudescence of the products field is significant.

Twenty-Five Papers Presented

Some twenty-five papers and twenty-two committee reports were presented in the ten sessions in the four days. Of the reports, twelve were merely of progress, eight presented tentative standards, and two final standards adopted to be sent to letter ballot. The adopted standards were a set of definitions by Committee G-4, on Nomenclature and the revised edition of the well-known specification on stucco by Committee C-3, on Treatment of Concrete Surfaces. The specifications and recommended practice accepted by the convention as tentative were as follows:

Tentative Standard or Recommended Practice
Concrete building block and tile
Concrete brick
Concrete floors
Monolithic concrete sewers and design rules
Rec. prac. for concrete fuel oil tanks
Rec. prac. for treatment of exterior surfaces
Concrete staves
Concrete roads

Of the committees which presented progress reports, the most important was that by Committee E-6, on Destructive Agents and Protective Treatment, which submitted the results of an extended inquiry into the effect of sea water on concrete. This inquiry consisted of a review of the literature of the subject and a questionnaire sent out to about seventy-five men who have had experience in sea-water work. "Of the fifty-one replies received to the ques-

tionnaire," says the report, "all but one gave approval to the use of concrete in fresh or in sea water and they were universal in stating that their general experience led them to believe that the failures of concrete in sea-water service were attributable to either improper material or poor workmanship." The report is an excellent review of the present stage of knowledge of sea-water construction situation, but does not contribute anything new. It contains, also, some review matter on the effect of alkalies, oils, high temperatures, and acids. Committee E-7, on Waterproofing, reported that it had organized for an intensive investigation of the much debated waterproofing subject. Committee P-5, on Fire Resistance of Concrete Buildings, gave a preliminary report of the tests on concrete block walls made at the instance of the Institute at the Underwriters' Laboratories last year, and these tests have not yet been fully reported so that definite conclusions are not yet available. Committee P-1, on Contractors Plant, concluded its investigation of the relative merits of different types of concreting plant for buildings, an investigation started last year.

Some Papers Abstracted

The more important of the papers presented are abstracted on another page of this issue. These include the main conclusions of the papers by W. A. Slater and G. A. Smith on the Inundation method for measuring sand in making concrete with the explanations of some practical applications therefrom by R. L. Bertin of the White Construction Co., of New York, who devised the method. This inundation method was explained briefly in *Engineering News-Record*, June 22, 1922, p. 1047, when it was first proposed by Mr. Bertin. It has since been tested at the Bureau of Standards as reported by Messrs. Smith and Slater.

The basis of the method is the assumption that the varying moisture in the sand, which results in a varying strength in a uniformly proportioned concrete, can be overcome by dropping the sand into a receptacle of water, the resulting saturated sand having the same quantity of water content regardless of its original moisture. This assumption was confirmed in large degree by the Bureau of Standards tests.,

One session was devoted to a discussion of concrete stadiums, the principal paper by Prof. C. T. Morris, of Ohio State University, describing in considerable detail the new stadium at that institution (see *Engineering News-Record*, Oct. 19, 1922, p. 640). Prof. Morris gave the unit costs in some detail, but he stated that they were subject to revision. The cost per seat was about $22, but this includes rather elaborate ornamentation and extensive use of under-stand space. H. T. Campion, of New York, in describing the new Franklin Field stand for the University of Pennsylvania, said the seat costs there were $15.64 for the permanent stand, including also architectural effects and interior finish. At Ohio the costs, barring decorations, etc., would have fallen to about $19, and at Philadelphia to about $11. R. L. Bertin described briefly the framing of the Yankee stadium at New York City.

Prof. D. A. Abrams, of Lewis Institute, reported some rather surprising tests on the effect of impure waters used in mixing concrete. The tests were in two series, extending over strength test periods of two years and involved the use of a number of different impure mixing waters, ranging from sea water, both artificial and real, to that from the infamous Bubbly Creek in Chicago. Contrary to the general opinion held on this subject, the tests showed that, with the exception of the heavy salt solution (more than 10 per cent) and the waste water from oil and tannery plants, there is little decrease in strength due to polluted water. Even the Bubbly Creek water, heavy with organic refuse, showed little decrease in strength from a pure water. For some reason, however, all tests with pure as well as with impure water showed a falling off in strength at two and one-third years. Another set of tests reported by G. W. Hutchinson, of the North Carolina State Highway Department, gave the correction coefficients which had been found by tests should be applied to cylinders of different dimensions than the standard 6x 12-in. Prof. Abrams reported similar tests that had been made in his laboratory.

Decorative Concrete Session

In an evening devoted to decorative concrete J. C. Pearson, of the United States Bureau of Standards, talked interestingly on the subject of concrete house construction, which he has been investigating for some time. Mr. Pearson feels that the development in this line must be along either an all-concrete house or a concrete wall house with steel or steel and concrete interior, and that the concrete exterior with frame interior if of little greater permanence or fire resistance than an ordinary frame house. He said that in the development of the concrete house further propaganda must insist on the saving in amortized cost. The same evening Lorado Taft, a Chicago sculptor, gave a delightful talk on "The Fountain of Time," that remarkable concrete group which has just been finished at the entrance of the old Midway in Chicago. Mr. Taft explained how the idea of this monumental group had been growing in his mind for many years but seems impossible of accomplishment on account of the difficulty of material until he had learned of the work done by J. J. Earley in exposed aggregate concrete casting. Mr. Earley later described the rather intricate structural requirements of the casting of the statue.

A brief paper by John J. Ahlers, of New York, described the preliminary tests made to determine whether a premixed aggregate such as was used in a building in New York City reached the concrete mixer in the same gradation as it left the aggregate mixing plant. Mr. Ahlers' tests are not yet complete, but as presented they were rather severely criticised from the floor.

Last year an innovation was introduced by Prof. Abrams and Stanton Walker, of Lewis Institute, in the way of an actual demonstration of the method of proportioning concrete devised by the laboratory there. This year this method was used for three papers, one by Mr. Walker to illustrate the products manufacturers, how they may best proportion their aggregate; one by R. F. Havlik, of Mooseheart, Ill., to illustrate how they make molded concrete products at his institution, and the last by Prof. Slater and Mr. Bertin to demonstrate the inundated sand principle of proportioning. The bringing before the audience of the actual material and methods proved well worthwhile. A question box was another novelty that took up one afternoon's session. Many questions had been asked by members and were answered by other members to whom they had been assigned. This feature resulted in a discussion of current problems in concrete difficult to report on in detail, but appreciated by those present.

The Wason Medal for the most meritorious paper presented to the Institute last year was awarded to Prof. George E. Beggs, of Princeton University, for his paper "An Accurate Mechanical Solution of the Stresses in Indeterminate Structures by Use of Paper Models and Special Gages." Prof. Beggs presented at this year's convention some supplementary notes on the applicability of these methods to actual structures.

W. P. Anderson, of Cincinnati, was re-elected president, and Harvey Whipple, 1807 East Grand Boulevard, Detroit, Mich., secretary.

New Mississippi Flood Bill

Washington Correspondence

A determined effort will be made to pass a new Mississippi River flood control bill at this session of Congress. The flood control committee of the House has agreed on a bill which now is on the calendar. The bill authorizes the appropriation of $10,000,000 annually for an indefinite number of years; money to be used for channel improvement and for federal aid in levee construction. It simply extends the provisions of the existing flood control act whereby two-thirds of levee construction is paid by the federal government and the remaining one-third by the local interests, but the local interests are required to furnish the right-of-way and maintain the levee, which makes the actual cash outlay practically equal for each of the contributors.

The committee before reporting out the bill considered a plan whereby the local interests would be allowed to deposit levee board bonds with the Secretary of the Treasury in lieu of a cash payment. Due to the heavy expense incurred during the high water of 1922, many of the levee boards are in financial straits. The scheme was rejected as being impracticable, however.

The committee also rejected a plan to limit the appropriation to $100,000,000. The existing flood control act was limited to $45,000,000. The last of that amount will have been expended during the next fiscal year and there still are long stretches of levee which have not been brought to the grade and cross section prescribed by the Mississippi River Commission. Now that the jurisdiction of the Commission has been extended to tributaries, the total cost of levee and revetment work becomes more problematical than ever. For that reason the committee decided to resort to the continuing type of authorization.

Technical Societies Hold Annual Meetings

State Organizations of Illinois, Indiana, Colorado, Iowa, and Engineering Institute of Canada, Discuss Pertinent Topics

Illinois

PROVISION for including engineering expenses in cost estimates for special assessment ordinances was one of the most actively discussed subjects at the annual meeting of the Illinois Society of Engineers held at Peoria, Ill., Jan. 23-25. Support of a movement for suitably amending this law was voted.

With successive sessions assigned to particular branches of engineering a wide field was covered by a well balanced program. In sanitary engineering, a review of sewage disposal in Illinois showed that 62 of 127 plants have only single-story tanks, the others having either one- or two-story tanks with supplementary filters of various types. A discouraging feature, however, is the almost universal lack of attention to the operating conditions of these plants. This review was by H. F. Ferguson, state sanitary engineer, and Paul Hansen, consulting engineer. The activated sludge process was discussed by Dr. A. M. Buswell, Chief of State Water Survey, along the lines of his article in *Engineering News-Record* of Jan. 18, p. 119.

Predicting Well Boring Results

Predicting the results of deep well borings by study of geological conditions was the subject of a paper by W. T. McClenahan, Chicago, and water supplies from gravel in the Illinois valley were discussed by G. C. Habermeyer, engineer, and M. M. Leighton, geologist, of the State Water Survey. Of particular local interest were two papers relative to the Illinois River, since Peoria claims that the Chicago drainage canal pollutes the water and causes floods. An address by F. W. Mohlmann, chemist of the Chicago Sanitary District, showed the fallacy of the first complaint, while M. G. Barnes, chief engineer of the State Waterway Division, showed records indicating that increased flood heights of recent years are largely the result of channel restriction by levees for land protection and of the straightening of tributary streams, thus hastening their runoff.

Open or closed specifications for asphalt pavement were discussed at some length, but mainly in favor of the "open" system on account of greatly reduced cost for work of equal quality. Experiments with sprinkling calcium chloride on concrete roads to hasten the curing have given excellent results according to H. F. Clemmer, of the State Highway Division. If the material remains on the surface for six hours it gives its full effect and need not be renewed if then washed off by rain. Two papers relating to highway traffic were on automobiles and motor truck operation, by Prof. Hewitt of the Bradley Polytechnic Institute (Peoria) and on the effective lighting of roads to facilitate night traffic, by Prof. A. R. Knight, University of Illinois.

A successful malaria-mosquito campaign at Carbondale, Ill., was outlined by H. F. Ferguson, chief sanitary engineer, State Board of Health, and A. F. Dappert, assistant sanitary engineer. By swamp drainage, clearing ditches and water courses, oiling and covering rain-water barrels and putting fish in wells and cisterns, the number of malarial cases was reduced in one season from 267 to 19, or 4.26 to 0.3 per cent of the population. An item of this work was the excavation of a drainage ditch by explosives. Both the engineering and commercial aspects of land drainage were illustrated in a paper by J. W. Dappert, Taylorville, Ill., describing the reclamation, cultivation and settlement of a tract of some 90,000 acres near Albert Lea, Minn., as described in *Engineering News-Record* of Oct. 6, 1921, p. 552. This was one of the papers accompanied by moving pictures, which were a feature of the meeting.

H. E. Babbitt, assistant professor of sanitary engineering, University of Illinois, was elected president. E. E. R. Tratman, Wheaton, Ill., (associate editor of *Engineering News-Record*) is vice president and secretary.

* *

Indiana

A DESCRIPTION of the power, development work in progress on the Tippecanoe River at Monticello, Ind., was a feature of the annual meeting of the Indiana Engineering Society, held at Indianapolis, Jan. 18 and 19. The plant will have a present capacity of 10,000 hp. but is designed for an ultimate capacity of 30,000 hp. The paper on this plant was read by Roger M. Freeman, consulting engineer, New York. A power generating and distribution project of the Central Indiana Power Co., which provides for interconnection of several plants in order to secure economic operating results, was described by L. B. Andrus, chief engineer of Kelsey, Brewer & Co., Grand Rapids, Mich. Officers for 1923 were elected as follows: President, John L. Elliott, city engineer of Indianapolis; vice-president, Prof. D. D. Ewing, Purdue University; secretary, Charles Brossman, Indianapolis, Ind.

* *

Colorado

ONE hundred thirty members of the Colorado Society of Engineers attended the seventh annual meeting held in Denver, Jan. 20. R. M. Hosea, retiring president, read a review of the year's activities of the society and urged the engineers to go into the study of economic problems, as an aid to their professional work.

Officers elected are: W. M. McMechen, president; Fred C. Steinhauer, vice-president; C. M. Lightburn, secretary-treasurer; R. J. Randall, R. G. Hosea, J. J. Vandemoer, I. C. Crawford, R. J. O'Rourke, W. R. Hellyer and A. K. Vickery, directors.

Mayor Bailey, of Denver, and Frank N. Briggs, former president of the International Trust Co., addressed the engineers on the progress and the needs of the city and state.

Engineers addressing the meeting were: Frank Shepard, Thomas B. Stearns and Delph Carpenter.

Engineering Institute of Canada

PAST-PRESIDENTS of the Engineering Institute of Canada are to establish a fund to provide medals and prizes for the best papers on engineering subjects submitted to the institute throughout any year. This anonuncement was made by J. M. R. Fairbairn, a past-president, at the annual convention of the institute held at Montreal, Jan. 23. Gold medals will be given members and cash prizes to students. Already a fund of $2,350 has been subscribed.

Arthur St. Laurent was elected president of the Institute as noted in these columns last week. George A. Walkem, president of the Vancouver Machinery Depot, and Walter J. Francis, consulting engineer of Montreal, were elected vice-presidents.

J. G. Sullivan, chief engineer of the Canadian Pacific and retiring president of the Institute, indicted union labor as it exists in Canada, asserting that union organizations had not lived up to their avowed purpose—improving the condition of the worker. He said that much work was hampered by the operation of restrictive union rules, and that a great amount of the inefficiency of union organizations could be laid to the professional labor leader. He recommended the industrial shop plan of co-operation as a means of improving the relation between capital and labor.

* *

Iowa

AS the Iowa Engineering Society is playing a prominent part in furnishing to legislators on bills pertaining to engineering, one session of the annual meeting of the society held Jan. 23-26 at Des Moines, was attended by the code revision committee of the house and senate. Although it was the camp fire meeting usual yarn-swapping and ballyhoo entertainment features were obscured when, by request of the legislators, papers on highway development, traffic regulation and taxation, given at an earlier technical section meeting, were repeated. Members of the committee entered into the discussion, asking questions and noting pertinent information.

For several years the engineers have discussed proposed bills or changes in bills on highways, drainage, and sanitation but repeatedly have been put off awaiting general code revision. The engineers' legislative committee of the society of which C. H. Young is chairman, acts as a clearing house in getting information to the legislators. Statewide publicity and effective work on specifications for drainage and pavements were further notable activities reported at the meeting, which was attended by about 300 engineers and guests. Younger men were decidedly in evidence.

The publicity committee, under the chairmanship of W. J. Schlick, has been effective in attracting the attention of the legislators. Publicity is sought on the principle that when legitimate for the engineer's work, it is necessary; and that before the engineer can change his status greatly he must think and act as a citizen as well as an engineer. With these points in view letters were sent each member of the society urging him to submit articles of his year's

(*Continued on page* 227)

Speedy Trial of War-Fraud Suits Urged by A.G.C.

Consideration of Federal Indictments Against Members Features First Day at Los Angeles Meeting

Engineering News-Record Staff Report

Consideration of the federal government's suits against war-camp contractors and of the indictments of seven individuals connected with the letting of war-construction contracts was the principal feature of the first day of the fourth annual convention of the Associated General Contractors which was held in Los Angeles this week. At the close of the first day, Tuesday, there was a registration of 350, including about 100 ladies. At the afternoon session the finances of the organizations were considered and the reports of the committees on legislation and publications approved.

In the annual address the retiring president, Arthur S. Bent, of Los Angeles, characterized as the chief recent accomplishments of the construction industry the development of "pride of calling" with a consequent erection of ideals and standards and the impressing on the public the importance of the construction industry. As factors in these accomplishments he reviewed the work of the association during the past year stressing the beginning of standardization conferences with equipment manufacturers, co-operation with technical societies on standard contract forms, the securing of release of open-top freight cars and the co-operation on contract provisions with the American Association of State Highway Officials.

Turning to the war-contract indictments and suits he repainted vividly the picture of war stress under which the contractors were called in to do their almost impossible tasks. Now, nearly five years later, they are branded as conspirators against the government and as profiteers. He maintained that the industry should meet the challenge and demand an immediate trial for the charges reflect on the whole industry. If the men were guilty the industry would be first to repudiate them.

Immediately following Mr. Bent's address D. A. Garber, as chairman, presented the report of the committee appointed to investigate these same federal indictments and suits. The report pointed out that the fees paid camp contractors had averaged 2.7 per cent on $100,000,000 of work and that after careful study two committees of experts had approved the form of contract as the only one feasible under the conditions. The report recommended that these and other facts constituting a review of the situation be referred to the Resolutions Committee as a basis for resolutions expressing the sentiment of the association. This recommendation was approved.

Announcement was made that at a meeting of the joint committee of the association and equipment manufacturers standard specifications for wheelbarrows had been agreed upon and had been referred to the manufacturers for approval. It is hoped to draw up standards for various features of the important classes of equipment and to urge the advocacy of these A.G.C. standards upon all contractors.

Under the head of finance there was a lengthy discussion of dues, some advocating the present plan of a percentage on the contractor's gross business and others a flat basis with higher dues for a sustaining-member class. The advocates of the latter plan contended that the percentage method was keeping out the small contractor. No decision was reached, the completion of the discussion being laid over until the budget was considered.

The publications of the Association were discussed, bringing out strong an approval of the present publication policies.

Colorado Assigns Highway Funds

The Colorado State Highway Commission has apportioned $6,777,596 for construction of highways in 1923. The report of the highway advisory board has been approved by the governor of the state. Of the total to be spent, $3,161,691 represents entirely new construction, the remaining sum being left over from the previous three years. Federal-aid projects total $5,272,700 and state projects, $1,494,896.

According to a statement issued by Maj. L. D. Blauvelt, state highway engineer, most of the construction during the coming season will be on main north and south, and east and west highways.

May Fix Professional Salaries by Executive Order

Washington Correspondence

An executive order may have to be issued to provide an adequate scale of salaries for professional positions in the government service. Congress has wrestled with this question for more than two years, and now as the session is about to close, the reclassification legislation seems to be jammed hopelessly. It is just possible that Congress, on learning that the President is prepared to meet this situation by an executive order, may compromise its differences and provide the long-needed legislation.

If an executive order is issued, it is believed the scale would be about as follows: chief professional, $7,500 and up; full professional, $5,700 to $7,500; associate professional, $4,500 to $5,700; assistant professional, $2,460 to $4,500; junior professional, $1,860 to $2,460. The Brown report on reorganization now is promised for Feb. 1.

Sacramento Filter Intake to Be Completed Below Estimate

The intake conduit leading from the Sacramento River to the filtration plant being built for the City of Sacramento, Calif., is now about 75 per cent complete and it is definitely stated that as all hazardous portions of the work are done the total cost can be placed about $98,000. This figure is $33,000 under the city engineer's estimates and about $60,000 less than the lowest bid received at the opening on Sept. 19 when bids were rejected and it was decided to do the work by day labor under the direction of the city engineer.

A résumé of the rearrangement in design and plan of construction was published in *Engineering News-Record* Oct. 26, 1922, p. 719.

John W. Cowper Is Elected President of A.G.C.

John W. Cowper, new president of the Associated General Contractors, whose election took place at the Los Angeles convention early this week, since 1915 has been president of a Buffalo contracting concern which bears his name. Previous to that time he had been in the vice-president's office of the Lackawanna Bridge Co. and before that engineer for James Stewart & Co. engaged in erecting buildings for the plant of the British Westinghouse Electric & Manufacturing Co. of Manchester, England.

Mr. Cowper has had extensive engineering experience, having been first employed in an engineering capacity by the department of sewers in the city engineer's office at Chattanooga, Tenn. in 1888. For the next five years he was in the engineering department of the Cincinnati Southern and the Alabama Great Southern Rys. on construction and maintenance-of-way work. From 1896 to 1899 he was engineer, maintenance-of-way, Cairo division, in charge of track, bridges and buildings on 270 miles of the C. C. & St. L. Ry. He became engineer, maintenance-of-way, of the St. Louis division of the same railroad in 1901 and placed in charge of maintenance of track, construction and bridges, buildings and incidental work on 265 miles of track.

Mr. Cowper has taken an active part in the A. G. C. activities for several years past. He is vice-chairman of the Joint Committee on Uniform Contracts, composed of members of the A. G. C. and from other societies. He has also been chairman of the Associations Committee on Contracts.

Half Million in Damage Suits for Knickerbocker Collapse

Suits for damages for the death of persons killed in the collapse of the Knickerbocker Theater roof in Washington on Jan. 28, 1922, were filed during the past week to an aggregate amount of nearly half a million dollars. Seven damage suits filed previously bring the total well over half a million. Some of the suits are directed at the Knickerbocker Theater Co., owners of the theater, and others also against its president, the architect of the theater, the steel contractor (and designer), and the District of Columbia.

The theater company has demurred to certain of the suits, on the ground that the declarations failed to show any act of negligence on the part of the company. Representatives of the plaintiffs argued in reply that the happening of the accident proved negligence, and referred to the legal doctrine that the owner of a place of entertainment warrants the premises to be reasonably safe for the purpose. The District Supreme Court, in which the suits are brought, has not yet made a decision on the demurrer.

Hoover Urges Engineering Unity at Loweth Luncheon

Profession Has Failed to Account for Fact Government is Applied Science of Economics

Washington Correspondence

With more than his usual earnestness, Commerce Secretary Hoover made a plea for unity among engineers in the course of remarks at a luncheon tendered Charles F. Loweth, the new president of the American Society of Civil Engineers, at Washington, on Jan. 23. Secretary Hoover declared that the civil engineers should not raise secondary questions when that course interferes with engineers as a whole doing their full duty to the country.

As a result of the inadequacy of transportation, the public is being driven into a clamor for public ownership of the railroads he pointed out. It even may be an issue in the next campaign, he predicted. Mr. Hoover declared that he is against this proposition and said the country is not within 200 years of the time when such an undertaking could be handled successfully.

The Federated American Engineering Societies is not in a position to throw the weight of its influence into the study of the transportation problem because of the failure of the civil engineers to co-operate, he said. As a result the country is confronted with a situation of utmost gravity and the engineers are not united to urge its solution along sane lines. The only ones in contact with the situation in Washington are those who are interested on either one side or the other, he continued.

Government, Secretary Hoover said, is the applied science of economics. Engineers have not taken that fact into sufficient account, he said, as the dominating thing in engineering today is the interpretation of economic forces, yet the profession is not a unit in Washington, the point from which their efforts in the national welfare must issue.

Mr. Loweth did not reply to Secretary Hoover. His remarks had preceded those of the Secretary of Commerce. At that time he called attention to the fact that if the American Society of Civil Engineers should not arrange to co-operate through American Engineering Council, the organization itself would make arrangements for close co-operation with the government. It evidently was this reference to the alternative which led Secretary Hoover to speak as he did.

The luncheon was organized by John C. Hoyt, retiring director of the Am. Soc. C. E. for the Washington district.

City of Bergen, Norway, Invites Bridge Plans

An international competition has been announced by the municipality of Bergen, Norway, for the submission of plans and drawings for new bridge over Nygaardstrommen in Bergen. Further particulars regarding the competition may be secured upon application to the Bergen Road Board, Bergen, Norway, by a deposit of 50 kronen. The latest date for submitting plans is June 30, 1923. The outline of the program is printed in Norwegian, German and English.

Iowa Engineers Discuss Technical Problems

(*Continued from p.* 225)

work to the local newspaper. One engineer in each county was asked to prepare a tax analysis for local distribution. Twenty articles were published and 35 tax analyses made.

Work in the drainage section on standard specifications for levees, open ditches and tile drains has been under way for several years. With minor changes those submitted last year were adopted.

Prof. T. R. Agg presented a set of suggested specifications on concrete, brick, asphalt, coarse aggregate bituminous concrete and bitulithic pavements for municipal and primary road paving projects containing essentials that the state highway commission would require.

Technical papers and discussions (more than 20) were confined largely to drainage, highways, mechanical-electrical, municipal, railroad and structural-architectural. Claude C. Coykendall's suggested solution for the Iowa highway transportation problem elicited spirited discussion and interest. C. W. Eby's discussion on the regulation and taxation of motor buses and trucks presented the citizen's more or less disgruntled viewpoint, emphasizing the complaints of the inequality of taxation, undue destruction by the small percentage (0.54) of 5-ton trucks, arguments for the proposed 2-cent gasoline tax and objections to the state highway commission because it advocates a large construction program but no remedy for the equalization of taxes.

Municipal technical papers related to sick sewer systems, infiltration of ground water, town planning, refuse disposal and water supply status in the state and reasons for failures in asphalt paving. The structural-architectural section heard papers on Prof. A. H. Fuller's impact studies on the Skunk River bridge near Ames, Prof. Byron J. Lambert's new design of an all-steel grandstand at Iowa City, and a discussion on the design of reinforced-concrete circular tanks by William Hewett.

The newly elected officers are: President, Lloyd A. Canfield; vice-president, C. C. Coykendall; and new director, J. D. Wardle. Mr. Canfield's place as secretary has not yet been filled by the board of directors.

Engineers Discuss World Congress

A conference on plan and scope for an international engineering congress, to be held at the time of the sesquicentennial celebration in Philadelphia, was held in New York Tuesday, Jan. 9. The meeting was held in accordance with plans previously initiated by the Engineers' Club of Philadelphia, which organization requested the four founder societies and the Am. Soc. T. M. to meet in conference to discuss a world engineering congress in 1926.

Some twenty-five or thirty prominent engineers in the four founder societies and the Federated American Engineering Societies attended the conference. It was the general opinion that a real opportunity for knitting together technical bodies of various countries was present in the proposed world congress.

The meeting was called to order by Richard L. Humphrey who is also the chairman of the committee on plan and scope. Nothing definite was attempted various committeemen merely discussing what can be done in the matter of cementing international engineering ties through the medium of the world congress.

Various technical associations are represented in the world congress movement by the following men:

Am. Soc. C. E., George S. Webster and Richard L. Humphrey.

A. I. M. E., J. Vipond Davies and Charles F. Rand.

A. S. M. E., James Hartness and D. Robert Yarnall.

A. I. E. E., Arthur E. Kennelly and Charles E. Skinner.

F. A. E. S., J. Parke Channing and L. P. Alford.

The Engineers' Club of Philadelphia, W. C. L. Eglin and Charles E. Billin.

Engineering Societies

Calendar

Annual Meetings

AMERICAN RAILWAY ENGINEERING ASSOCIATION, Chicago; Annual Convention, Chicago, March 13-15.

AMERICAN ASSOCIATION OF ENGINEERS, Chicago; Annual Convention, Norfolk, Va., May 7-9.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia; Annual Meeting, Atlantic City, N. J., June 25-29 or 30.

The Pacific Northwest Chapter of the A. G. C. will hold its convention in Seattle, Feb. 9-10. Besides eastern delegates, on the Coast attending the general convention of the association, members from Idaho, Oregon, British Columbia and Washington will participate. W. L. Clist is chairman of the convention committee.

Personal Notes

BRIG.-GEN. WILLIAM BARCLAY PARSONS, deputy chief engineer, G. H. Q. Organized Reserve, and during the World War commander of the 11th Engineers, has been awarded the Distinguished Service Medal which will be conferred upon him at 2nd Corps Area Headquarters, Governors Island, N. Y. on Feb. 1.

LIEUT. WILLIAM J. HORRIGAN, Chemical Warfare Service, U. S. Army, has resigned and has opened an engineering office at Louisville, Ky. He will specialize in sanitary, hydraulic and structural engineering.

M. T. CANTELL, of Winnipeg, Can., architect and engineer for the Northeastern Contruction Co., has been elected a fellow of the Royal Society of Arts, England, in recognition of his work in the advancement of architecture and engineering.

HON. PETER J. VENIST, minister of public works, has been appointed prime minister of the Province of New Brunswick, Can.

FRED MCELMON, Bellingham, has been elected county engineer of Whatcom County, Wash., succeeding J. C. HILLS.

ROBERT LILE has been appointed street superintendent of Livingston, Calif.

FRANCIS R. MOLTHER, recently engaged on railway location from the port of Tumaco to Pasto and from Pasto to Popayán, Colombia, S. A., has accepted a position with F. P. Platt & Bro., architects, New York City.

D. G. SCOTT, of Henderson Harbor, N. Y., has been appointed by the board of supervisors of Jefferson County, N. Y., as county superintendent of highways, to succeed CAPT. HENRY D. BALL, who died recently.

O. S. FINNIE, director of the Northwest Territories and Yukon Branch of the Department of the Interior, has been elected chairman, for the coming year, of the Engineering Institute of Canada, Ottawa Branch.

FRANK R. GOODMAN, state engineer of Arizona, announces the selection of his staff as follows: Assistant engineer, W. W. LANE; district engineers, northern, B. M. ATWOOD, eastern, W. R. HUTCHINS, central, CLYDE L. JENKIN, southern, EDWARD TEN EYCK; superintendent of equipment, P. J. HARRISON.

E. J. FOSTER has been appointed county engineer of Webb County at Laredo, Tex.

GEORGE CARLETON BROWN has recently been promoted from the position of resident engineer with the Michigan State Highway Department to that of district engineer in charge of maintenance, with headquarters at Ann Arbor. The latter position was made vacant by the resignation of W. W. SHANOR, who has become associated with the Rockford Construction Co., Rockford, Ohio.

N. D. COLE has been appointed office engineer to R. V. Glenn, consulting engineer of the Tarrant County, Texas, Highway Department. D. A. DAVIS, until recently the office engineer of the Tarrant County Highway Department, has been appointed county engineer.

ALVIN L. WHITE has been appointed county engineer of Brewster Co., Texas, with headquarters at Alpine.

W. J. KELLY, of Trinity, Texas, has been appointed county engineer of Montgomery Co. He is stationed at Conroe, Texas.

G. M. O'ROURKE, roadmaster of the Indiana division, Illinois Central R. R., has been appointed to a similar position on the St. Louis division, with headquarters at Carbondale, Ill., to succeed J. W. Kern, Jr. promoted to district engineer at New Orleans.

C. W. LENTZ, chief building inspector, Illinois Central R.R., has been appointed roadmaster of the Indiana division, with headquarters at Mattoon, Illinois.

ANDREW HAMILTON, of Hamilton & Shreve, consulting engineers, Fayetteville, Ark., has been made district manager and consulting engineer with the National Lime Association, with headquarters at Dallas, Tex. WALTER SHREVE will continue consulting engineering work at Fayetteville, as the firm has the contract for the construction of the Fort Smith-Greenwood road.

L. W. WEED, recently concrete engineer with Helmle & Corbett, architects, of New York, and before that associated with the Turner Construction Co., has joined the staff of Day & Zimmermann, Inc., of Philadelphia, as concrete engineer.

H. C. BOTTORFF, city comptroller of Sacramento, Calif., since Jan. 1, 1921, and assistant city manager since the city manager form of government was instituted, has been appointed city manager of Sacramento, succeeding Clyde L. Seavey.

HARRY H. HUME, Butte County (Calif.) road engineer, has been reappointed for a four-year term by the board of supervisors. He was appointed two years ago to fill the vacancy caused by the resignation of Martin C. Polk.

W. H. GORDON, formerly engineer at the Napa, Calif., state hospital, has been appointed engineer of the municipal water-works in that city.

GEORGE FESSENDEN has been appointed county engineer and surveyor, and ROBERT FLEMING has been appointed county highway engineer of Flathead County, Mont., with headquarters at Kalispell.

GEORGE LE BOUTILLIER has been elected vice-president and a director of the Long Island R.R. to fill the vacancy caused by the death of Thomas Dewitt Cuyler. Mr. Boutillier has served the Pennsylvania railroad system for 27 years. Until recently he was located at Harrisburg, as general superintendent of the Eastern Pennsylvania division. He has been consecutively assistant engineer, division engineer, engineer of maintenance-of-way, division superintendent and general superintendent.

COL. L. H. RAND, former executive officer of the California Debris Commission and who has been in charge of river and harbor work on the Sacramento and San Joaquin Rivers, is now actively participating in the consulting engineering work carried on by the Cope Rand Means Company, San Francisco. Col. Rand resigned from the U. S. Army in July, 1922.

W. G. BROWN has been appointed engineer, maintenance-of-way, Florida East Coast Ry., and CALVIN OBERDORF, engineer of construction, of the same road. Both report to the office of the general manager in St. Augustine, Fla.

MAJOR JULIAN L. SCHLEY, Corps of Engineers, U. S. Army, has been awarded a distinguished service medal for meritorious service as commander of the 307th Engineers, and for service with the 5th Army Corps during the St. Mihiel and Meuse-Argonne offensives. The presentation was made by COL. J. A. WOODRUFF, commandant of the Engineer School at Fort Humphreys, Va.

Obituary

HON. RICHARD C. PARSONS, internationally known as a water works and drainage expert, died in London, Jan. 26, aged 71 years. He superintended the design and construction of the water and drainage works for the City of Buenos Aires and prepared complete designs for a drainage system for the City of Petrograd in 1908. He was a member of the Institution of Civil Engineers of Great Britain and the Society of Civil Engineers of France, of the Institution of Mechanical Engineers and other technical and educational organizations. He had contributed many articles to scientific societies.

FRANK W. HODGDON, prominent along the Atlantic Coast for work in harbor improvement, died Jan. 26 in Boston. At the time of his death he was chief engineer, Division of Waterways, Massachusetts Department of Public Works, and had been associated with harbor work in Boston since his graduation from the Massachusetts Institute of Technology in 1876, at first with the Harbor Commission in connection with the improvement of the South Boston piers and then as engineer for the Land Commission. In that capacity he designed and superintended construction of pile platforms at two piers opened by the New Haven road. From 1879 to 1893 he was assistant engineer of the Harbor and Land Commission, becoming its chief engineer and serving until 1912 in that capacity. In 1897 Mr. Hodgdon was appointed a member of the Commission on Topographical Survey of Massachusetts and in 1898 was a member of the Massachusetts-New Hampshire Boundary Line Commission. From 1908 until 1912 he was consulting engineer for the Florida Coast Line Canal and Transportation Co., and in 1911 was a member of the Commission of Engineers in the Costa Rica-Panama boundary arbitration, representing the Republic of Panama in the boundary negotiations.

C. H. HOLLINGSWORTH, widely-known contractor and for several years associated with The A. Bentley & Sons Co., of Toledo, Ohio, died in Boston, Jan. 4. Mr. Hollongsworth was a graduate civil engineer, having studied at Halifax University, Nova Scotia. He came to the United States early in his professional career, his first employment being in the engineer's office of the city of Newton, Mass. During his lifetime he had charge of many large construction enterprises throughout the United States, Canada and Mexico, some of the most noteworthy of which were water-power development at Sault St. Marie, Mich.; water-power development for the city of Quebec; day superintendent on the Manhattan end of the Pennsylvania R.R. East River tunnels, New York City general superintendent on twenty-two dams of concrete and earth construction in Mexico; general superintendent on the contract for one section of the New York-Catskill aqueduct; and general superintendent for the construction of Camp Sherman at Chillicothe, Ohio, and Camp Joseph E. Johnson at Jacksonville, Fla.

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

Concrete Pipe Association Hears Engineers

Progress of the year's tests on culvert pipe at Iowa State College, together with tentative conclusions, were given the American Concrete Pipe Association at the technical session of the convention Jan. 19, 20 and 21 in Chicago by Dean Anson Marston. Some of his deductions were as follows:

(1) A real demand exists for increased strength of pipe. (2) Enough definite data have not yet been obtained to write a final specification. (3) While engineers are inclined to design so no cracks will appear, 36-in. cracked pipe 3 in. out of round have stood for at least three years. (4) A factor of safety of 1¼ over laboratory breaking stress leaves only a slight margin. (5) Additional culvert pipe research costing $30,000 is needed.

Two men are to be put in the field this season to collect data on existing culverts. Embankments are to be built over 24-in. pipe finally to determine the ratios of possible increase in strength by more than ordinary careful bedding and by concrete cradles. Laboratory tests are to be continued on impact due to trucks. Improvements in the type of reinforcing will be sought.

Langdon Pearse, sanitary engineer, Sanitary District of Chicago, spoke of the work of the district and in discussion indicated that the only difficulty with concrete disintegration was in a sewer carrying slow-moving septic sewage without outlet for the hydrogen sulphide. Ventilating manholes were placed to remedy the situation.

W. G. Chace, chief engineer, Lock Joint Pipe Co., during his talk on the work of the company, explained the details of the high-pressure joints.

Alfred N. Shearman was elected president for the fifth time. M. W. Loving continues as secretary and G. E. Warren as treasurer.

Motor Industry Made Record Railway Shipments in 1922

"Shipping of assembled automobiles from main factories and assembling plants during the past year reached the record figure of approximately 400,000 carloads, transporting 1,700,000 machines," as reported by William E. Metzger, chairman, traffic committee, National Automobile Chamber of Commerce to the directors' meeting of that association recently. In addition, more than 750,000 machines were driven away by dealers from factories and assembling plants.

Manufactured parts, the report states, amounted to about 100,000 carloads and it is not unlikely that this heavy shipping will place automobiles and parts third in the number of carloads of manufactured articles shipped on the railroads. In 1921 it ranked fourth, being exceeded only by refined petroleum, iron and steel products, and cement. Much of the refined petroleum and a considerable part of cement and iron and steel shipping, however, is the direct result of motor car manufacture and use.

New box cars with extra wide door openings, known as automobile cars, to the number of 18,000, have been included in railway equipment orders during the past year, which will bring the total of such cars in service up to 111,000.

Concrete Mixers Shipped Abroad

During November, 1922, figures from the U. S. Department of Commerce show that 22 concrete mixers valued at $15,531 were shipped for export trade. England was the biggest consumer, with 5 mixers costing $2,949.

During the same month 56 conveyors costing $43,767 were shipped abroad. Construction equipment not specifically classified totaled, during November, 314,278 lb., valued at $59,368.

Associated Equipment Distributors Hold Annual Meeting

In addition to a representative attendance of member companies, 82 manufacturers of construction equipment and materials, in addition to a number of well-known contractors, attended the annual meeting of the Associated Equipment Distributors held in Milwaukee, Jan. 12-13. The program for the first day covered a discussion of the relations between contractors and equipment distributors. Among the speakers were F. J. Herlichy, White Construction Co., Chicago; C. G. Milburn, Siebert-Milburn Co., Columbus; H. E. Smith, president, T. L. Smith Co., Milwaukee; George J. Kirkgasser, Chicago. A discussion of service and replacement of defective parts was opened by E. D. Townsend, president of the association.

The meeting on the second day was closed to members of the association and covered discussion of rental contracts, restriction of sales contracts, and salesmen's salaries. Among the speakers were A. C. Aslesen, Minneapolis Equipment Co., Minneapolis; Morton R. Hunter, Hunter Machinery Co., Milwaukee; and George B. Curd, George B. Curd Equipment Co., Cincinnati.

William F. Tubesing, president of the Builders & Traders Exchange of Milwaukee and also head of the contracting company bearing his name, urged manufacturers not to deluge contractors with circular mail matter regarding their equipment, but rather to present the merits of their machinery through the medium of trained representatives. He urged uniformity in catalog sizes, standardization of repair parts and the publication of accurate repair parts booklets from which a contractor may order correctly. Mr. Tubesing made the point that standard parts should be listed as such, with the result that nuts, bolts, piston rings and similar items could be purchased locally with a considerable saving in time.

More Suggestions—

For Better Equipment and Repair Parts Service

IN the Dec. 14 issue was begun a discussion of "Better Equipment Maintenance and Repair Parts Service." Its object is to show how some of the misunderstandings between maker and user of construction machinery can be avoided. This week's contribution is a recital of experiences by manufacturers of hoists and of crushers.

From the Lidgerwood Manufacturing Co., New York

WE believe regular plant inspection on the job would be of considerable benefit to the user. In addition, we find that several of our contracting friends are following a plan which saves them much trouble. Upon the completion of a job the engine is sent to their yard or storehouse, is thoroughly inspected and cleaned up, defective parts replaced or repaired, and the engine put in condition so that it will be ready to go out on another job.

To the matter of supplying repair parts this company has given considerable study. Each hoist, as built, is given a shop number. We do not experience any difficulty in connection with repair parts provided the customer gives with his order the following information: (1) Shop number of the hoist; (2) name of the part; (3) whether the part is for right or left-hand side of hoist, or for the front or rear. If this information is omitted from the order we, of course, cannot be certain that the order will be correctly filled. We publish a duplicate part list which explains this matter fully to the customer.

From a Maker of Rock Crushers and Gravel Handling Plants

TWO points about the maintenance of rock crushers may be of value: (1.) Most contractors, including quarry and gravel-pit operators, do not provide an adequate stock of repairs for their rock-crushing equipment. In the mining field the average crusher operator is very careful to stock a duplicate of every part in the crusher which is likely to require replacement on short notice. In the contracting field, however, the opposite policy prevails. Even the less expensive, but sometimes very important, parts are not ordered until urgently needed; and occasionally a plant may be shut down for several days, waiting for a small part that should have been ordered months before.

For instance, last summer a road contractor in North Carolina neglected to carry spares for two vital but not expensive bearings in his crusher. These bearings were accidentally burned out during the railroad strike. Duplicates were ordered by express and were shipped promptly by the factory. The express company, however, was swamped with heavy shipments at that time and the goods took a long time in transit. The job was held up 10 days.

(2.) Ninety per cent of all crusher trouble is caused by attempting to force the machine to make too great a ratio of reduction. In his excellent work on "Ore Dressing," Prof. Richards recommends a maximum ratio of reduction of 5 to 1. That is, if the crusher has a receiving opening of 10 in. Prof. Richards recommends that the discharge opening should not be less than 2 inches.

We have frequently found it possible to operate successfully on soft rock, like limestone, with a reduction ratio of 6 to 1. That seems to be the limit of safe reduction. Nevertheless, we continually find cases where contractors are forcing a crusher to do double service, making a reduction of 8 or 9 to 1. This practice increases the pressure on the bearings and augments the load on every part of the machine to such an extent that wreckage is almost certain if the practice is continued for any length of time. The results are the same no matter what type of machine is used. In many cases the user has been warned against attempting too great a reduction ratio, but simply ignores these warnings.

To Be Continued

Review of Construction Equipment and Materials During 1922—Part IV

DEVELOPMENTS in construction equipment and materials during 1922, as noted in "Engineering News-Record's" review beginning in the Jan. 4 issue, took the form of improvements in details rather than in new types of machines. Previous installments of the review included power shovels, concrete chuting equipment, industrial locomotives, elevating loaders, rock crushers, road graders, mixers, and concrete road building plant, buckets, cranes, hoists, gasoline engines, air compressors and pneumatic tools. With this week's installment the review is concluded:

Material Haulage Equipment

IMPROVEMENTS in equipment for transporting material consist mainly of details—nothing new has been added to the standard types of dump-car, batch-box car, dump-wagon, trailer, tractor, and truck. Greater ease of operation is being secured through a more general use of roller bearings and industrial tracks of less sharp curvature than were formerly common. More batch boxes are being made of steel. Tractors witnessed a wider use in the construction field during the year, particularly in road grading. On motor trucks the introduction of a two-range transmission makes possible the utilization of maximum power only when needed. Trucks with short wheel bases and special bodies were developed for road-building work and in the trailer field devices were introduced to facilitate haulage in trains.

C. L. Best *Tractor Co.*

ON ITS 60-hp. unit the Best company has changed the final drive from an internal gear to a heat-treated cut nickel steel spur gear, thoroughly inclosed and running in a bath of oil. Steering controls have been improved for easier operation. On the 30-hp. unit an improved form of sprocket tooth has been adopted which is less liable to clog in operating in snow or soft loose soil.

General *Motors Truck Co.*

THE OUTSTANDING feature added to G M C trucks, especially for contractors' use, during 1922 was the two-range transmission. The first range is for rapid movement on good roads, and the second for increased pulling power, at lower speeds, on poor roads or with heavy loads. With this transmission power is conserved by applying the maximum effort of the engine only when needed.

Lakewood *Engineering Co.*

SEPARATE cement compartments are being provided in Lakewood batch boxes and an increasing use of steel for this type of equipment is noted. To assist in discharging cement diagonal chains in cement compartments have been introduced. On batch-box cars roller bearings are employed to reduce wear and improve traction. On industrial track the advantages of pressed steel ties riveted to the rail are emphasized and easier curves—60-ft. radius, instead of 30 ft.—are being employed to minimize derailments.

Stroud & Co.

WHILE THE design of the "Little Red" dump wagon has remained unchanged, the company has brought out three new models of larger wagons, the capacities being from 2 to 10 cu.yd.

Republic *Truck Sales Corp.*

A SHORT wheel-base, 110 in., is a feature of the Republic road-building truck, which may be equipped with 1- and 2-cu.yd. batch bodies. The weight is evenly distributed, approximately 40 per cent of it being carried on the front axles. The truck can turn in a radius of 15½ ft. Pneumatic tires are employed. Three types of body design are furnished.

Watson *Products Corp.*

TO ADAPT its bottom-dump wagons for operation in trains the Watson corporation has developed a train hitch so constructed that all the pull comes on a heavy chain passing under the line of wagons. There is claimed to be no more strain on each wagon operating in a train than when they are hauled singly by a team of horses. With the train-hitch wagons are coupled simply by slipping a link over a hook. The units may readily be changed from train wagons to horse-drawn wagons.

Western *Wheeled Scraper Co.*

FOR RAILWAY maintenance of way the Western air-dump car is fitted with an apron designed to throw material beyond the ends of the ties in a railway track when discharging.

This extension floor or apron can be attached to any Western dump car. When the car is dumped, the apron, which ordinarily hangs in an upright position, moves out automatically extending the floor 28 in.

On the company's batch-box car changes in design provide for increased strength and size of axles and bearings and the use of a center sill.

Cableway Excavators and Loaders

EXCEPT for improvements in details designed to increase speed and capacity, cableway excavators and loaders underwent no important changes during the year. For small scale operations a new type of portable drag scraper outfit was introduced.

Link-Belt Co.

FOR STORING coal and handling sand, gravel and crushed stone a "power hoe" or drag scraper was announced.

Sauerman Bros.

A PORTABLE drag scraper outfit was introduced for small-scale operations in utilizing local sand and gravel deposits. The power equipment is a double-drum hoist furnished with gasoline engine direct-connected or arranged for belt drive from a tractor.

On its larger dragline cableway excavators Sauerman Bros. have increased the size of the power units to handle larger yardages of material than formerly.

T. L. Smith Co.

ON ITS excavator and loader the Smith company this year installed a four-cylinder Wisconsin gasoline engine, providing about 40 per cent additional power over previous equipment. These excavator and loader units are designed for general dragline work, digging basements and loading directly into wagons or trucks on the surface.

Wood Block

IMPROVEMENTS in creosoted wood paving block included a countersunk lug feature and built-up sections of wood block for installation at points of intersection between railroads, car lines and streets.

Jennison-Wright Co.

THE Jennison-Wright Co. added to its line of Kreolite lug wood block by introducing a countersunk lug with grooves on either side. The counter-

sunk feature enables the lugs to remain of standard dimensions for any separation desired, while the grooves and open joints between the blocks permit the penetration of a bituminous filler to the full depth. When compression occurs the grooves serve as reservoirs for collecting surplus filler.

A new type of wood block paving for railway crossings is made up in sectional mats; it can be quickly removed, without injuring the material, when the track needs repair. This type of paving is built up within a framework and floor made to fit the area between tracks at a crossing. Creosoted wood blocks are nailed to the floor of this framework.

Steel Reinforcement and Building Products

IN the field of concrete building construction several additions to previous types of steel reinforcement were made during the year. Among them was an I-beam in heights of from 4 to 8 in., with the top flange sheared to form rigidly connected diagonals extending into the concrete above, thus producing a unit of reinforced-concrete beam and slab. A development in the steel joist line was the introduction of the plate girder type of joist made from strip steel in a variety of sizes, gages, and sections. Several types of self-furring metal lath or fabric reinforcement were developed.

National *Steel Fabric Co.*

FOR STUCCO work a combined reinforcement and base consisting of galvanized steel fabric to which is fastened a backing of waterproof paper was one of the year's products. The paper backing is attached to the fabric by crimps, which also serve as a self-furring feature, holding the material at a uniform distance from the background. The paper backing, it is claimed, reduces waste from droppings and with it no forms are called for.

Truscon *Steel Co.*

FOR THE reinforcement of concrete structural work the Truscon—I construction was introduced to combine the steel economy of reinforced concrete and the saving of form-work in structural steel. This reinforcement consists of a series of I-beams manufactured in a variety of sizes from 4 to 8 in. high, with top flange sheared to form rigidly connected diagonals extending into the concrete above. The Truscon—I's are thus integral with the concrete, making a unit of reinforced-concrete beam and slab. A system of removable steel forms, suspended from the I's, is provided. Steel Floretyles are ordinarily used with this type of construction.

New steel joist sections of the plate girder type were announced during the year in a variety of sizes and gages; prongs in the flanges for attaching Hy-Rib are furnished where required.

In the company's sectional steel buildings an alternative for standard panels is offered in the form of steel windows extending continuously and supported by curtain walls of any material. A steel basement window for houses and apartment buildings was introduced and an additional new product was a self-furring lath with dome-like projections formed every 4 feet.

Pipe

CAST-IRON pipe is now being manufactured in the United States by the centrifugal process, in which a rapidly revolving mold is used. Another development which has made progress during the year is the production of large diameter steel pipe—from 20 in. to 8 ft.—by the hammer-weld method, eliminating all rivets and projecting ribs.

National *Tube Co.*

THE HAMMER-WELD process was perfected for the production of pipe from 20 in. to 8 ft. in diameter. By this method steel plates are bent into tubular form and the overlapping edges are welded, after they have been heated, by hammer forging on an anvil block. The addition of the larger sizes of pipe made possible by this process enables the National Tube Co. to meet practically all wrought tubular requirements with a range from ⅛ to 96 in.

U.S. Cast Iron *Pipe & Foundry Co.*

INCREASED strength and lighter weight of pipe have been made possible through the introduction of the de Lavaud centrifugal process of casting undertaken by the U. S. Cast Iron Pipe & Foundry Co. In this process molten metal is poured into a horizontal cylindrical mold which is rapidly rotated by an impulse wheel. The mold is water cooled. Tests show that the tensile strength of the centrifugally cast metal is 37,000 lb. per square inch as against 16,000 lb. per square inch for sand-molded metal.

Business Notes

MACKINTOSH ENGINEERING CO., Cleveland, Ohio, has been appointed agent for the Brownhoist small cranes, buckets and storage bins. The territory will cover all of Ohio, with the exception of Hamilton County. The line of equipment will include steam, gas engine, and electric cranes mounted on creeper trucks, road wheels, or four or eight-wheel railroad trucks.

AMERICAN CONCRETE PIPE ASSOCIATION announces the appointment as assistant secretary of J. A. Dunn, formerly field engineer for the Portland Cement Association.

T. H. NEEDHAM has been appointed manager of the Houston, Tex., office of the Uvalde Rock Asphalt Co., 906 Goggan Building.

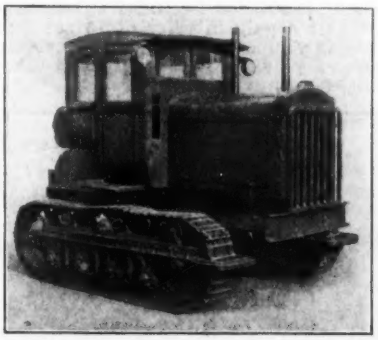
THE TEXAS AMIESITE CO. has opened offices in Ft. Worth at 1909 F & M Building.

SOUTHERN PINE ASSOCIATION will hold its eighth annual meeting at the Hotel Grunewald in New Orleans, La., March 20 and 21. During the same week and in the same city the NATIONAL LUMBER MANUFACTURER'S ASSOCIATION will hold its annual meeting.

Equipment and Materials

New Model Crawler Tractor Has Six-Cylinder Engine

A six-cylinder, 60-hp. gasoline engine, instead of the four-cylinder unit previously used, is one of the features of the new model tractor just announced by Monarch Tractors Inc., Watertown, Wis. For all-year round work the tractor is equipped with an inclosed cab and mounted on three heavy silico-manganese springs which form a flexible three-point support. The



general features of the design of the new unit are shown in the accompanying photograph.

Pistons, connecting rods, bearings, valves and springs on the new six-cylinder machine are interchangeable with those on the four-cylinder engine heretofore used. The tractor is equipped with three-speed transmission and an electric starter. A built-up frame of angle iron carries the crawlers, which are of manganese steel. The Monarch principle of mounting the drawbar on the crawlers only is continued in the new model. A coil spring is introduced to prevent excessive shock in starting.

Publications from the Construction Industry

Feed-Water Heaters—H. S. B. W.—COCHRANE CORP., Philadelphia, in a new 60-p. illustrated booklet, discusses feed-water heaters in their relation to steam plant efficiency. The text is not primarily descriptive of apparatus, but rather a presentation of the theory and practice of boiler feed water heating. Various forms of apparatus and their uses are presented, including vacuum deaërating heaters, back-pressure heaters, heaters in conjunction with make-up water evaporators, feed-water heating by stages, different methods of control for securing continuous heat balance, heaters in connection with exhaust steam heating systems, heaters in conjunction with hot water heating and service systems, including heaters operated at temperatures below 212 deg. F., combined heaters and softeners and combined heaters and feed water meters. The feed water temperature best for plant efficiency is not a sharply defined quantity, as it is found that the temperature can vary through quite a wide range without seriously affecting overall economy.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

January Contracts Higher by 16 per Cent

Industrial Works and Bridges Show Heaviest Increases—Big Gain in Water-Works

Contracts awarded during January on important engineering projects in the United States and Canada reached a total value of $142,599,000 as against $123,143,000 for December. This represents a gain in value of 16 per cent and in volume 6 per cent. The increase over a year ago is 75 per cent in value and 30 per cent in volume.

Minimum costs observed in Construction News on each class of construction are as follows: Water-works, $15,000; other public works, $25,000; industrial construction, $40,000 and commercial buildings, $150,000.

Industrial works gained about 32 per cent in January, while the value of bridge contracts was six times as great as the December lettings.

Two sections of the country did not show construction gains: the Southern and the New England States. In New England, figures were about the same as for the preceding month, while the South declined considerably. The heaviest lettings of the month were in the Middle West, valued at $42,329,000 as against $37,648,000 in the Middle Atlantic states, making the fifth time during the last thirteen months that this group has surpassed the usual high record of the Middle Atlantic states. An increase of 25 per cent is reported in Canadian lettings for the first month of the new year.

The actual number of contracts awarded last month in relation to money values is shown in the following comparison with December:

Water-Works—The gain in January was in the average value per contract: 26 jobs averaged $192,000, against 28 projects, averaging $71,000.

Bridges—This classification gained in both value and number of contracts: 31 jobs averaged $225,000, compared with 19 averaging $52,000 per contract.

Streets and Roads—Gains both in number and total value of contracts were realized during January: 131 jobs with an average value of $168,000, as against 98 averaging $183,000.

Industrial Works—Fewer contracts were awarded in January but with a higher average value: 98 averaging $255,000, as compared with 116 averaging $163,000.

Buildings—While the value of contracts fell off $3,000,000 in January, the total number of awards was greater: 162 buildings averaging $413,000 as against 144, with an average value of $486,000 in December.

Federal Government Work—January contracts increased in both number and value: 24 jobs averaged $250,000, compared with 22 averaging $104,000.

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for in Construction News, pp. 55 to 68, are the following:

An office building at Montreal, Que., for Montreal Insurance Exchange. $3,000,000.

An apartment at Philadelphia, Pa., for Lincoln Drive Apartment Co. $2,000,000.

A pier at Philadelphia, Pa., for Phila. & Reading R.R. $1,500,000.

A sewer project at Denver, Col., for the city. $2,000,000.

A hotel at Paterson, N. J., for Alexander Hamilton Hotel. $1,000,000.

A temple at Ft. Wayne, Ind., for Masonic Bldg. Co., $1,000,000.

A school for the Board of Education at Oakland, Calif. $100,000.

Bank Debits for the week ending Jan. 24 totaled $9,237,000,000, or more than a billion under the preceding month.

Engineering News-Record Construction Cost Index Number

February, 1923	197.40
January, 1923	191.70
February, 1922	168.72
Peak, June, 1920	273.80
1913	100.00

Engineering News-Record's Construction Cost Index Number advanced 5.7 points since last month, due to higher steel and lumber prices, and stiffening in labor rates. Steel rose to $2.10, from $2.00 per 100 lb., Pittsburgh mill. The average rate for common labor is now 48c. Thus, general construction cost is 17 per cent higher than one year ago and 28 per cent under the peak; it is 97.4 per cent above the 1913 level.

Engineering News-Record Construction Volume Index Number

Monthly	
January, 1923 (*4 issues of E. N.-R.*)	126
December, 1922 (*4 issues of E. N.-R.*)	111
January, 1922 (*4 issues of E. N.-R.*)	91
1913	100
Yearly	
1922 (entire year)	130
1921 (entire year)	88
1920 (entire year)	91
1913	100

Engineering News-Record's Construction Volume Index Number is 126 for the month of January, and 130 for the whole of 1922, as against 100 for 1913. This means that the actual volume of construction in 1922 (not the mere money-value of the contracts let that year) is 30 per cent above the volume of construction for 1913. Our monthly volume number, 126 for January, 1923, is really the increment of construction, and indicates the rate at which contracts are being let as compared with 1913 awards.

VALUE OF CONTRACTS LET IN THE UNITED STATES AND CANADA DURING JANUARY, 1923

	New England	Middle Atlantic	Southern	Middle West	West of Mississippi	Western	Canada	Total
Water-works	.....	$1,094,000	313,000	$151,000	$3,068,000	$36,000	$58,000	$4,720,000
Sewers	.....	60,000	96,000	1,717,000	501,000	571,000	377,000	3,322,000
Bridges	$95,000	1,023,000	1,090,000	597,000	2,545,000	150,000	1,400,000	6,900,000
Excavation, drainage and irrigation	.....	200,000	.....	25,000	45,000	278,000	.....	548,000
Streets and roads	.....	2,814,000	3,085,000	3,023,000	9,923,000	2,846,000	.....	21,691,000
Industrial works	2,775,000	3,371,000	1,395,000	12,751,000	3,731,000	485,000	300,000	24,808,000
Buildings	7,867,000	26,498,000	2,501,000	20,226,000	4,419,000	5,294,000	.....	66,805,000
Federal Government	.....	2,028,000	1,305,000	982,000	.....	1,195,000	.....	5,510,000
Miscellaneous	60,000	560,000	361,000	2,857,000	1,159,000	512,000	2,786,000	8,295,000
	$10,797,000	$37,648,000	$10,146,000	$42,329,000	$25,391,000	$11,367,000	$4,921,000	$142,599,000

Construction in 1922 and Outlook for 1923

The construction of public works and of buildings established in 1922 a new record for volume. In large works and fireproof building construction, statistics show that the volume in 1922 was 47 per cent greater than in 1921. Building permits alone, in 166 cities, according to the Federal Reserve banks, showed an increase of 57 per cent for the first nine months of this year as against the first nine months of 1921. As to all building and construction work, the increase will easily amount to 33 per cent above 1921. The total expenditure involved is estimated at not less than four and a half billion dollars; of this figure three billions is accounted for by actual tabulated figures.

The largest part of the general increase in construction has been in the building line, as the figures quoted above indicate. Extensive road construction, greater activity in the building of industrial plants and a small increase in the amount of railroad work have all contributed to the making of the record.

The outlook for 1923 is distinctly encouraging. The volume of highway work will probably not be less, though in many quarters tax payers are looking askance at increasing tax rates. There will probably be somewhat more railroad work; while, with increasing prosperity, more activity can be looked for

Labor Rates and Conditions Throughout the Country

Well sustained business activities and an extensive general recovery in nearly all industries, have marked the first month of the new year. Despite a slight improvement in transportation facilities, particularly in the shipment of building materials, dealers are urged to prepare for a possible car shortage during the first half of 1923.

Factors pointing toward expanding industry are as follows: (1) Value of contracts let last month was 16 per cent greater than in December; (2) heavier sales of fabricated steel; (3) increasing coal output and prompter handling; and (4) record retail sales.

The adverse factors are the car shortage, scarcity of labor (particularly in the steel mills), and the disturbed foreign situation.

Conditions in the building industry, relative to wage schedules and an adequate labor supply, are visibly improving throughout the entire country.

The common labor rate for the nation, as applied to pick and shovel men in construction operations, is placed at 48c. per hr. as against 47c. for the preceding two months, according to *Engineering News-Record's* figures. Local industrial conditions are as follows:

Atlanta—Open winter favors building. Wages tending upward. Bricklayers demand $1.12½ per hr. from April 12.

Baltimore — Carpenters' strike on. Scarcity of hodcarriers. Normal supply in other trades. Hodcarriers receive 87½c. as against 60@75c. per hr. The minimum rate in the accompanying table is that paid non-union mechanics; the higher figure represents the union wage.

Boston—Labor plentiful with the exception of hoisting engineers. Weather conditions tieing up construction operations.

Cincinnati—All classes of building trades mechanics plentiful.

Dallas — Ample supply of common laborers. Small surplus of skilled men.

Denver—No unemployment. Some workmen paid slightly above the union scale.

Detroit—Very little unemployment. Conditions normal in all trades.

Kansas City — More carpenters needed; plenty in other skilled trades. Possibilities of hodcarrier shortage in spring. Demand for first class common laborers.

Montreal—Scarcity of plasterers. No shortage of other skilled trades.

New Orleans—Lumber mills no longer handicapped by car shortage. Labor plentiful.

New York—Agreements reached between employers and most of the skilled building trades for the coming season. The 1922 wage schedule will continue in effect, with the exception of marble workers, who demand an increase of $1 per day over last year's rate. Clauses removing all restrictions on production; prohibiting strikes and lockouts and providing for arbitration of all disputes between employers and unions, are contained in the agreements.

Philadelphia—Scarcity of bricklayers, hodcarriers and common laborers. High rates being paid these trades wherever men are obtainable. Fair supply of hoisting engineers, pile drivers and structural iron workers.

Pittsburgh — Secretary of Builders' Exchange urges co-operation in eliminating labor and materials shortages. Builders in the past, he says, harmed the industry by bidding against each other in an effort to get skilled workmen.

St. Louis—Bricklayers rate $1.25; but owing to shortage, as high as $1.37½ per hr. frequently paid. Carpenters will demand $1.25 on and after May 1, as against present rate of $1.10 per hr. Hoisting engineers plan to apply for the same rate as carpenters after May 1. Common laborers, non-union, receive 40@50c. per hr. as compared with 30@45c. last month.

San Francisco—Present wage schedule will remain in effect for one year beginning Jan. 1, 1923. Plenty of employment for all trades.

(Higher rates indicated by +, decreases by—)

Cities	Bricklayers	Carpenters	Hoisting Engineers	Hod Carriers	Pile Drivers	Structural Iron Workers	Common Labor
Atlanta	$0.90	$0.70	$0.70	$0.30	.....	$0.65	$0.30@.35
Baltimore	1.25	+.80@.90	+.80@1.00	+.87½	—$0.65	.80@1.00	.30@.45
Birmingham	1.00	.75	.50@1.00	.15@.25	.....	1.00	.20@.25
Boston	1.25	1.00	90@1.00	.75@.80	1.00	1.00	.50@.60
Cincinnati	1.25	.95	.95	.72½	.....	.95	.35@.40
Chicago	1.10	1.00	1.10	.....	1.10	1.05	.72½
Cleveland	1.25	1.10	1.10	.75	.91	1.10	.75
Dallas	1.37½	1.00	1.00	.40	.87½	1.00	.30@.50
Denver	1.25	1.00	1.00	.75@.81¼	1.00	1.03¼	.35@.50
Detroit	1.12½	.80	.80@.90	.50@.60	1.00	.60@.80	.50
Kansas City	1.12½	+1.00@1.25	1.00@1.25	.80	1.00	1.00	.30@.50
Los Angeles	1.25	1.00	1.00	1.12½	.87½	1.00	.56¼@.62½
Minneapolis	1.00	.80	.80	.65	.....	.80	.35@.50
Montreal	.90	.65	.50	.35	.50	.60@.65	.25@30
New Orleans	1.00	.85	.90	.65	.80	1.00	.35@.40
New York	1.25	1.12½	1.25	.87½	1.00	1.12½	.45@.60
Pittsburgh	1.30	1.12½	1.00	.90	1.00	1.00	+.50@60
St. Louis	1.25	1.10	1.12½	.85	1.12	1.12½	+.40@.50
San Francisco	+1.25	1.00	1.00	+.81¼	1.00	1.12½	.50@.56¼
Seattle	+1.12½	+.87½	+.87½@1.00	+93¾	1.00	+.90@1.00	.50@.60½
Philadelphia	+1.25@1.37½	.90@1.00	.90@ 1.00	+.75@1.00	1.00	+.90@1.10	+.40@.65

in factory construction. In municipal public works, the volume is not likely to decline, because our cities have not yet caught up with their programs, delayed by the war. Moreover, the demand for their tax-exempt securities will probably still be active, so that the needed funds can readily be raised.

The one adverse factor is cost, which has been rising since last March and is now about 17 per cent higher than it was a year ago. On the other hand, the average cost of construction of all kinds in 1922 was 14 per cent under the average cost of 1921.

Skilled and common labor are still high, and, in the building field particularly, scarce. The average rate paid common labor as reported by twenty of the principal cities is 48 cents an hour and is rising. This contrasts with an unskilled rate of from 17 to 20 cents an hour before the war. Union wages, covering the skilled trades, are very high. The prospective demand for labor is such that a lowering of wages is not in sight.

Materials prices, too, will probably not decline, for the demand promises to keep pace with supply.

With increasing volume of construction in the early part of the year labor conditions are likely to tighten, increasing the difficulties of builders and contractors. This, in turn, may discourage the letting of contracts toward the end of the year, and thus decrease the volume of work performed in 1923.

All in all, the construction industry is justified in looking forward to a continuation in the immediate future of its present great activity.

Business Failures Gain Slightly in Week

All districts in the United States except the Pacific section show increases in the number of failures reported to R. G. Dun & Co., during the week of Jan. 27, whereas all except the Pacific section showed decreases for the preceding week. The total for the week ending Jan. 27 is 511, as against 482 for the week of Jan. 20, and 605 a year ago.

An approximately proportionate increase is evident in the number of defaults with liabilities of more than $5,000 in each instance; in the week of Jan. 27 they amount to 298, or 58.3 per cent. of the total, while in the previous period they numbered 280, or 58.0 per cent of the aggregate for that week. In the corresponding week of 1922, similar insolvencies were 368 in number, or 60.8 per cent of the total.

Failures reported from the Dominion of Canada are fewer than for the week of Jan. 20, 82 for the week of Jan. 27 comparing with 90 for the preceding period; a year ago the total was 104. Defaults involving more than $5,000 in each case number 41, as against 47 for the week previous and 53 a year ago.

Bill to Admit Alien Labor Before Senate

A bill to amend the joint resolution extending the operation of the Immigration Act of May 19, 1921, as amended by the resolution of May 11, 1922, was introduced in the United States Senate, Jan. 9, 1923, read twice and referred to the Committee on Immigration.

The proposed amendment contains the following provisions:

"That for the purpose of determining the annual quota of each nationality of otherwise admissible aliens due consideration shall be given to the emigration of aliens of such nationality during that year, and such calculation shall be made and announced at the end of each three months' period by the Secretary of Labor.

"The Secretary of Labor may, upon submission to him of satisfactory evidence that there is a continuing shortage of labor of a particular type or class which, after reasonable effort, has not been found unemployed in the United States, authorize contracts with and the admission of otherwise admissible alien labor to such extent as will in his judgment meet such established shortage, notwithstanding that such aliens so authorized to be admitted may exceed the quotas of their respective nationalities now admissible under this Act. The Secretary may prescribe reasonable rules and regulations for the presentation of evidence under this section."

Large Contracts Let During Week

Among the week's announcements of contracts awarded in Construction News, pp. 55 to 68, are the following projects:

An office building at New York City, N. Y., for F. T. Ley & Co. $6,000,000.

An apartment hotel at St. Louis, Mo., for A. M. Cornwell. $2,200,000.

A hotel at Los Angeles, Calif., for Davenport Corporation. $2,000,000.

An office building at Houston, Tex., for Houston Cotton Exchange. $1,500,000.

Monthly Prices of Construction Materials

Ups and Downs of the Market

Pig Iron—Higher pig-iron prices due to scarcity of iron and steel scrap. Both basic and bessemer quoted at $29.27 per ton, Pittsburgh, including freight charge from valley, as against $24.25 for basic and $27.50 for bessemer, one month ago.

Railway Supplies—Light rails up $3 per ton at mill. Rerolled rails also $2 per 100 lb. higher at Pittsburgh. Spikes and section angle bars advanced 15c. per 100 lb. during month.

Pipe—Wrought steel pipe discounts dropped two points on Pittsburgh basing card, during month; wrought iron pipe also tending higher. Cast-iron pipe market strong and very active in view of advancing pig-iron prices. Rises of $4 per ton reported in San Francisco; 50c.@$1.50 in St. Louis and $2 in Chicago; stiff advances in New York. Sewer pipe down about 4c. per ft. in Dallas; higher in Cincinnati and Seattle.

Road and Paving Materials—Seasonal dullness in road oil market. St. Louis, however, advances 1c. per gal. on 50@60 per cent asphalt, following rise of 10c. per bbl. in crude oil, Jan. 13. Average drop of about $2 per ton in asphalt, f.o.b., Minneapolis, Dallas and St. Louis. Stronger market anticipated in latter part of February, with opening up of spring bidding activities. Paving stone and wood blocks up 10c. per sq.yd. in Boston; lower in Kansas City.

Sand, Gravel and Crushed Stone — Upward tendency in price due to freezing weather and consequent impeding of shipments. Gravel up 15c. per ton in Cincinnati. Both sand and gravel, however, down 5c. per cu.yd. in St. Louis. Crushed stone up in Boston and Dallas; down in Kansas City.

Lime—Common lump lime $3@$3.25 per bbl., 280-lb. net, f.o.b. New York, as against $2.75@$3.13½, one month ago. Hydrated lime, both finishing and common, up 20c. per ton in St. Louis; hydrated common, higher in Atlanta. Hydrated down 50c. per ton in Boston; lump finishing declined $1 and common lump, 25c. per ton in St. Louis, since January 4.

Cement—Market reflecting seasonal decline. Price down 4c. per bbl. in Atlanta; 10c. in Boston, Kansas City and Philadelphia and 25c. in Montreal, since last month.

Structural Steel—Demand for steel plates and structural shapes continues active; mills well booked for present quarter, with prices firmly placed at minimum of $2.10 per 100 lb., f.o.b. mill. Quotations nearing minimum of $2.10 on bars, with tendency to go higher. Shapes now $3.29 as against $3.14 per 100 lb. in New York warehouses. Bars, $3.19 as compared with $3.04, one week ago.

Triangle Mesh and Metal Lath—Expanded metal lath advanced about 2 per cent in St. Louis and triangle mesh, 20 per cent in New York, due to increased costs of raw materials.

Brick and Hollow Tile—Common brick up $1 per M in Cincinnati and St. Louis. Seattle, Minneapolis and Dallas report drop of $1 per M during month. Slight reductions in hollow tile in Boston and St. Louis; higher in Minneapolis.

Lumber—With shipments 5 per cent and demand about 25 per cent above normal, the lumber market is unusually firm for this season of the year. The output, however, is about 22 per cent below normal. Douglas fir timbers advanced $3@$5 per M ft. in San Francisco, and yellow pine, $2, in New York, during January. Higher lumber-prices are reported in Boston, Seattle, New Orleans, Denver, Minneapolis, Birmingham and Philadelphia; declines in Atlanta, Kansas City and Detroit.

Scrap—Prices higher in New York and St. Louis; tendency downward in Chicago.

Explosives—Slight advances in Boston, Kansas City and Dallas; no declines.

Linseed Oil — Flaxseed market steadier. Prices unchanged in New York and Chicago, during month. Up 3c. per gal. in Atlanta and Minneapolis.

White and Red Lead—Both dry and in oil up ½c. per lb. in month; and advance of $1 per lb. since December.

Price advances since last month are indicated by **heavy type**; declines by *italics*

PIG IRON—Per Gross Ton—Quotations compiled by The Matthew Addy Co.:

	Feb. 1	One Year Ago
CINCINNATI		
No. 2 Southern (silicon 2.25 @ 2.75)	$27.55	$22.50
Northern Basic	29.27	22.02
Southern Ohio No. 2 (silicon 1.75 @ 2.25)	29.77	23.52
NEW YORK, tidewater delivery		
Southern No. 2 (silicon 2.25 @ 2.75)	33.44	28.50
BIRMINGHAM		
No. 2 Foundry (silicon 2.25 @ 2.75)	24.00	18.00
PHILADELPHIA		
Eastern Pa., No. 2X, (2.25@2.75 sil.)	29.76@30.14	22.26
Virginia No. 2 (silicon 2.25 @ 2.75)	33.17	28.74
Basic	28.00	20.75
Gray Forge	28.14	22.50
CHICAGO		
No. 2 Foundry Local (silicon 1.75@2.25)	29.00	21.70
No. 2 Foundry Southern (silicon 2.25 @ 2.75)	30.01	24.66
PITTSBURGH, including freight charge from the Valley		
No. 2 Foundry Valley (silicon 1.75 @ 2.25)	28.00	22.46
Basic	29.27	20.96
Bessemer	29.27	21.96

RAILWAY SUPPLIES

STEEL RAILS—The following quotations are per ton f.o.b. Pittsburgh and Chicago for carload or larger lots. For less than carload lots 5c. per 100 lb. is charged extra:

	Pittsburgh Feb. 1	Pittsburgh One Year Ago	Birmingham	Chicago	St. Louis
Standard bessemer rails	$43.00	$40.00	.....	$43.00	43.00
Standard openhearth rails	43.00	40.00	$43.00	43.00	43.00
Light rails, 8 to 10 lb.	43.00	1.55*	2.00*	43.00	43.00
Light rails, 12 to 14 lb.	43.00	1.55*	2.00*	43.00	43.00
Light rails, 25 to 45 lb.	43.00	30@36	2.00*	43.00	43.00
Rerolled Rails	28@32	1.45@1.50*	.....	.....	.....

*Per 100 lb.

RAILWAY TIES—For fair-sized orders, the following prices per tie hold:

	6 In. x 8 In. by 8½ Ft.	7 In. x 9 In. by 8½ Ft.
Chicago, White Oak	$1.50	$1.65
Chicago, Hardwood and Red Oak	1.25	1.40
Chicago....Empty Cell Creosoting (add'l)	.45	.50
San Francisco..... Green Douglas Fir	.84	1.17
San Francisco, Empty Cell Creosoted, Douglas Fir	1.60	2.25
St. Louis, White Oak	1.30	1.55
St. Louis (creosoted) (zinc treated)	1.70	2.05
St. Louis, Red Oak, plain	1.15	1.40
St. Louis, Sap pine-cypress	1.05	1.30

TRACK SUPPLIES—The following prices are base per 100 lb. f.o.b. Pittsburgh for carload lots, together with the warehouse prices at the places named:

	Pittsburgh Feb. 1	Pittsburgh One Year Ago	Chicago	St. Louis	San Francisco	Birmingham
Standard spikes, ⅝-in. and larger	$2.75@2.90	$2.30@2.35	$3.00	$3.60	$4.45	$3.29
Track bolts	3.75@4.50	3.00@3.25	4.00	4.70	5.45	4.29
Standard section angle bars	2.75@2.90	2.40	2.75	3.45	4.10	2.94

PIPE

WROUGHT PIPE—The following discounts are to jobbers for carload lots on the latest Pittsburgh basing card:

BUTT WELD

Inches	Steel Black	Steel Galv.	Inches	Iron Black	Iron Galv.
1 to 3	68@64	54½@53½	¼ to 1¼	34	19

LAP WELD

2	59@57	47½@45½	2	29	15
2½ to 3	63@61	51½@50½	2½ to 4	32	19
7 to 8	60@58	47½@46½	4½ to 6	32	19
9 to 12	59@57	46½@45½	7 to 12	30	17

BUTT WELD, EXTRA STRONG, PLAIN ENDS

1 to 1¼	64@62	53½@52½	¼ to 1¼	34	20
2 to 3	65@63	54½@53½			

LAP WELD, EXTRA STRONG, PLAIN ENDS

2	57@55	46½@45½	2	30	17
2½ to 4	61@59	50½@45½	2½ to 4	33	21
4½ to 6	60@58	49½@48½	4½ to 6	32	20
7 to 8	56@54	43½@42½	7 to 8	25	13
9 to 12	50@48	37½@36½	9 to 12	20	8

STEEL PIPE—From warehouses at the places named the following discounts hold for steel pipe:

	Black New York	Black Chicago	Black St. Louis
1 to 3 in. butt welded	57%	62½%	57%
2½ to 6 in. lap welded	54%	59½%	54%

	Galvanized New York	Galvanized Chicago	Galvanized St. Louis
1 to 3 in. butt welded	44%	48½%	44%
2½ to 6 in. lap welded	41%	45½%	41%

Malleable fittings, Classes B and C, banded, from New York stock sell at list less 1%. Cast iron, standard sizes, 29% off.

CAST-IRON PIPE—The following are prices per net ton for carload lots:

	Birmingham Mill	New York Feb. 1	New York One Year Ago	Chicago	St. Louis	San Francisco
4 in.	$47.50@48	$61.30	$50.30 $55.20@56.20		$53.60@54.60	$57.00
6 in. and over	43.00	56.60	47.30@48.30	53.20	49.60@50.60	56.00

Gas pipe and Class "A," $4 per ton extra; 16-ft. lengths, $1 per ton.

CLAY DRAIN TILE—The following prices are per 1000 lin.ft.:

Size, In.	New York Feb. 1	New York One Year Ago	St. Louis	Chicago	San Francisco	Dallas
3	$45.00	$40.00	$40.00	$82.50	.....	$55.00
4	55.00	50.00	40.00	75.00	$76.50	65.00
5	80.00	80.00	.....	100.00	97.75	84.00
6	105.00	100.00	75.00	175.00	127.50	110.00
8	170.00	150.00	170.00	187.50	212.50	181.00

SEWER PIPE—The following prices are in cents per foot for standard pipe in car load lots, f.o.b., except as otherwise stated:

Size, In	New York Delivered	Pittsburgh	Birmingham	St. Louis	Chicago	San Francisco	Dallas
3	$0.14	$0 105	.....	.....	$0.35	$0.12	.....
4	.14	105	$0.10	$0.0875	.15	.15	*$0.12*
5	.20	.1575	.125	.....	.23	.18	*.16*
6	.20	.1575	.150	.1225	.23	.21	*.1855*
8	.34	.245	.225	.20	.35	.30	*.30*
10	.51	.3675	.2925	.28	.53	.42	*.441*
12	.65	.4725	.3825	.36	.68	.54	*.567*
15	1.03†	.63	.5625	.60†	.90	.90	*.819*
18	1.50†	.875	.765	.84†	1.25	1.32	*1.071*
20	1.80†	1.05	1.0125	1.12†	1.50	.....	.....
22	2.40†	1.40	1.2375	.....	2.00	.....	*1.44*
24	2.70†	1.575	1.4625	1.44†	2.25	2.16	*1.89*
27	4.50†	2.795	.....	2.45†	4.69†	3.00	*3.54*
30	5.00†	3.096	.....	3.00†	5.94†	3.60	*4.06*
33	6.50†	4.14	.....	3.55†	6.88†	.....	*4.99*
36	7.50†	4.715	.....	3.95†	7.50†	.....	*5.48*

	3	5	8	12	24	36
Boston	$0.12	$0.185	$0.29	$0.55	$1.845†	$5.535†
Minneapolis	.....	.....	.40	.72	2.55	5.66†
Denver	.135*	.18*	.27	.47	1.70	.....
Seattle	*.13*	.....	.36	.72†	2.00†	.....
Los Angeles	.....	.....	.....	.....	.....	.....
New Orleans	.112*	.168*	.28	.476	1.82†	.....
Cincinnati	.111*	.1665	.259	.499	1.665	*4.32†*
Atlanta	.108*	.162*	.27	.459	1.75‡	.....
Montreal, *delivered*	.68‡	.45†	.70	1.35	4.50†	.....
Detroit	.102	.153	.238	.459	1.98†	6.15†
Baltimore	.117	.18	.273	.526	1.755	5.125
Kansas City, Mo.	.135	.19	.30	.54	2.16	.....
Philadelphia	12	.18	.28	.54	1.80†	4.10†

*4-in., 6-in., 9-in., respectively. †Double Strength. ‡3-in. special.

ROAD AND PAVING MATERIALS

ROAD OILS—Following are prices per gallon in tank cars 8,000 gal. minimum f.o.b. place named:

		Feb. 1	One Year Ago
New York, 45% asphalt	(at terminal)	$0.06	$0.05½
New York, 65% asphalt	(at terminal)	.06	.05
New York, binder	(at terminal)	.06½	.06½
New York, flux	(at terminal)	.06½	.05½
New York, liquid asphalt	(at terminal)	.07	.06
St. Louis, 50@60% asphalt		.0848	.01½*
Chicago, 40–50% asphalt		.05½	.05
Chicago, 60–70% asphalt		.05½	.05½
Dallas, 45% asphalt		.04	.10
Dallas, 55% asphalt		.048	.13
Dallas, binder		.053	.15
San Francisco, binder, per ton		9.50†	13.00†

* Freight $21.75 per ton to Whiting, Ind.
† F.o.b. Oleum, Cal. Freight to San Francisco, 80c. per ton.

ASPHALT—Price per ton in packages (350-lb. bbls. or 425-lb. drums) and in bulk in carload lots, f.o.b. points listed:

	Package	Bulk
New York (*Mexican*)	$20.00	$16.00
Boston (*Mexican*)	19.50	16.00
Chicago (*Standolind*)	*22.25*	*16.00*
San Francisco, *f.o.b. refinery*, Oleum, Cal.	17.00*	11.00*
Dallas, (*Texas*)	*23.00*	*15.00*
Seattle "*D*" *grade* (*California*)	*21.25*	*11.00*†
Denver (*California*)	40.00	
Minneapolis *f.o.b. Twin Cities* (*Standard*)	*25.45*	*19.10*
St. Louis (*Mexican*)	27.50	*19.75*
Baltimore (*Mexican*)	21.00	15.00
Los Angeles, *at factory*, *Bakersfield* (*California*)		
Montreal (*Imperial*)	28.00	21.00
Atlanta (*Mexican*)	22.00	16.50
Detroit (*Mexican*)	23.68	18.95
Cincinnati (*Mexican*)	22.50	19.50
Maurer, N. J. (*Trinidad and Bermudez*)	28.00	26.00
Maurer, N. J. (*Mexican*)	18.00	15.50
Philadelphia (*Mexican*)	20.00	16.00
Kansas City (*petroleum*)	*28.80*	*22.80*

*Freight to San Francisco, 80c. per ton.

†F.o.b. Richmond, Cal.

NOTE—Barrels or drums are optional in most cities. About 6 bbls. to the ton, and from 4 to 5 drums; 200 to 300 gal. to the ton.

PAVING STONE—

New York	5-in. granite, 30 blocks per sq.yd.	$4.45 per sq.yd.
Chicago	About 4x8x4 dressed	3.60 per sq.yd.
	About 4x8x4 common	3.15 per sq.yd.
San Francisco	Basalt block 4x7x8	70.00 per M
Boston	5-in. granite	2.10 per sq.yd.
Atlanta	Granite	2.10 per sq.yd.
Detroit	Granite, 26½ blocks per sq.yd.	100.00 per M
Baltimore	Granite	2.85 per sq.yd.
Montreal	Granite	100.00 per M
New Orleans	Granite, 4 x 8 x 4	3.25 per sq.yd.
Cincinnati	Granite	135.00 per M.
St. Louis	4x8x4 dressed	3.10 per sq.yd.
	4x8x4 common	2.90 per sq.yd.
Kansas City	Granite	*3.75* per sq.yd.
Philadelphia	Granite	130.00 per M.

FLAGGING—

New York	Bronx, 5 ft.	$0.50 sq.ft.
	Manhattan, 4 ft.	.35@.40 sq.ft.
	Queens, 5 ft.	.35@.40 sq.ft.
	6x20-in. cross-walk	1.00 lin.ft.
Chicago	18 in. wide	.99 lin.ft.

CURBING—Bluestone per lineal foot, delivered in New York, costs $2.40@2.75 for 5x16 in.; $3.50@4.00 for 5x18 in. Class "A" straight, 5x16 in., $1.40 per lin. ft. delivered in St. Louis. 5x18 in., Chicago, $3 per lin.ft., delivered.

WOOD BLOCK PAVING—

	Size of Block	Treatment	Per Sq.Yd.
New York (*delivered*)	3	16	$2.37
New York (*delivered*)	3½	16	2.63
Boston	3½	16	2.35
Chicago	4	16	3.00@3.25
Chicago	3½	16	2.50
St. Louis	3½	16	2.00
St. Louis	4	16	2.10
Seattle	4	16	Off market
Minneapolis	3½	16	2.09
Atlanta	3½	16	2.30
New Orleans	3	16	*1.75*
New Orleans	3½	16	1.95
New Orleans	4	16	2.25
Dallas	4	18	3.90
Baltimore	3½	16	none used
Montreal	4	16	4.50
Detroit	3	16	2.84
Detroit	4	16	3.00
Cincinnati	4	16	2.38
Kansas City	4	16	*3.15*
Philadelphia	3½	16	2.46

CONSTRUCTION MATERIALS

SAND AND GRAVEL—Price for cargo or carload lots to contractor is as follows, per cu.yd.:

	Gravel 1½ In.		Gravel ¾ In.		Sand	
	Feb. 1	One Year Ago	Feb. 1	One Year Ago	Feb. 1	One Year Ago
New York	$2.00	$1.75	$2.00	$1.75	$1.00	$1.00
Denver	1.90	2.50	1.90	2.50	1.90	1.10
Chicago	2.25	2.00	2.25	2.00	2.25	2.00
St. Louis	*1.40*†	1.25†	1.50†	1.50†	*1.40*†	1.20†
Seattle	1.00	1.50	1.00	1.50	1.00	1.50
Dallas	2.25	2.00	2.25	2.00	1.87½	2.00
Minneapolis	1.75*	1.50	1.75*	1.50	1.00	0.50*
Cincinnati	1.40†	1.00	1.40†	1.50	1.15†	1.50
San Francisco	2.15	2.25	2.15	2.25	1.50	1.50
Boston	1.40	2.65	1.40	2.65	1.10	2.00
New Orleans	2.85	2.08½	2.85	2.08½	1.35	1.35
Los Angeles		1.35†		1.35†		1.20†
Atlanta	1.75†	1.85†	1.75†	1.85†	*1.25*†	1.25†
Detroit	2.25	2.00	2.25	2.00	2.00	2.00
Baltimore	1.86	1.40	2.13	1.60	0.70†	2.00
Montreal	1.25†	1.25†	1.50†	1.50†	1.25†	1.25†
Birmingham (Crushed slag used instead of gravel)					1.25†	1.25†
Philadelphia	1.70	1.50	1.75	1.57	0.66*	1.60
Kansas City	2.00	2.00	2.00	2.00	0.66*	1.20

New York—Grit, $1.75 per cu. yd.
Los Angeles—Freight from quarry, 70c. per ton, and is included in above price.
* At pit.
† Per ton.

CRUSHED STONE—Price for cargo or carload lots f.o.b. city, unless stated otherwise, is as follows, per cu.yd.:

	1½ In. Feb. 1	1½ In. One Year Ago	¾ In. Feb. 1	¾ In. One Year Ago
New York	$1.65	$1.75@1.85	$1.75	$1.75@1.85
Chicago	2.25	1.60	2.25	1.60
St. Louis *delivered*	2.00	1.65@2.00*	2.10	1.65@2.00*
Dallas	1.80	2.93	1.80	2.93
San Francisco	2.15	2.25	2.15	2.25
Boston, *delivered*	1.85	3.00*	1.85	3.00*
Minneapolis, *at plant*,	2.00	2.00	2.25	2.25
Kansas City	*2.25*	2.10	*2.25*	2.10
Denver	3.50	3.50	3.50	3.50
Seattle *delivered*	3.00	3.00	3.00	3.00
Atlanta	2.00*	2.00*	2.00*	2.00*
Cincinnati	*1.55*†	2.37½	2.00*	2.08
Los Angeles		1.60*		1.70*
Detroit	1.90@2*	1.90*	1.90@2*	1.90*
Baltimore		1.75*		1.65*
Montreal	1.80*	2.00*	1.90*	2.10*
Birmingham *delivered*	3.20	3.20	3.10	3.10
Phildelphia	1.75*	1.70	1.60*	1.55
Pittsburgh	2.85	....	2.85	....
Cleveland	3.00*	....	3.00*	....

*Per ton.

CRUSHED SLAG—Price of crushed slag in carload lots, per net ton, at plants:

	1½-In.	¾-In.	Roofing	Sand
Youngstown District	$1.30	$1.30	$2.00	$1.30
Steubenville District	1.40	1.40	2.00	1.40
Ironton District	1.40	1.40	2.00	1.40
East Canaan, Conn.	1.25	1.35	4.00	1.00
Easton, Catasaqua, Pa.	1.00	1.00	2.00	0.90
Birmingham, Ala.	1.00	1.00	1.00	1.00
Buffalo, N. Y., and Erie, Pa.	1.25	1.25	2.25	1.25
Cleveland, Ohio	1.20	1.20	....	1.00
Eastern Pennsylvania and Northern New Jersey	1.20	1.20	2.00	1.20
Western Pennsylvania	1.25	1.25	2.00	1.25

LIME—Warehouse prices:

	Hydrated, per Ton Finishing	Hydrated, per Ton Common	Lump, per Barrel Finishing	Lump, per Barrel Common
New York	$16.80@$17.10	$13.10	$3.75*	$3.00@$3.25*
Chicago	18.00	18.00	1.50†	1.40†
St. Louis	22.40	19.20	*17.75*‡	*17.75*‡
Boston	*18.00*	*13.50*	3.90*	3.00*
Dallas	22.50	....	....	2.50†
Cincinnati	15.80	13.30	....	10.75‡
San Francisco	22.00	16.00	....	1.75†
Minneapolis	25.50	21.00 (white)	1.55†	1.40†
Denver	24.00	....	....	2.70†
Detroit	19.50	17.50	....	18.25‡
Seattle *paper sacks*	24.00	.....	2.80†	.....
Los Angeles	.....	.....	....	.....
Baltimore	22.00	16.25	....	.....
Montreal	21.00	21.00	15.00‡	11.00‡
Atlanta	23.00	20.00	2.25†	1.85†
New Orleans	.....	17.25	2.40†	.....
Philadelphia	15.50	14.50	13.00‡	12.00‡
Kansas City	25.60	24.00	2.40†	2.40†

*Per 280-lb. bbl. (net). †Per 180-lb. bbl. (net). ‡Per ton—Refund of 10c. per bbl. Minneapolis quotes brown common lump lime; Kelly Is. white is $1.55, Sheboygan $1.45. New York quotes hydrated lime "on cars" in paper sacks; lump lime "alongside dealers docks" or "on cars."

NATURAL CEMENT—Price to dealers per bbl. for 500 bbl. or over, f.o.b., exclusive of bags:

	Feb. 1	One Year Ago
Minneapolis (Rosendale)	$2.80	$2.80
Kansas City (Ft. Scott)	1.50	1.60
Atlanta (Magnolia)	11.00 per ton	11.00 per ton
Cincinnati (Utica)	1.72	1.93
Boston (Rosendale) per bag	....	0.85@0.95
St. Louis (Carney)	1.75	....

PORTLAND CEMENT—Prices to contractors per bbl. in carload lots f.o.b. points listed *without bags*. Cash discount not deducted.

	Feb. 1	One Month Ago	One Year Ago
New York, del. by truck	$2.60@2.70	$2.60@2.70	$2.20@2.30
New York, alongside dock to dealers	2.30	2.30	2.00
Jersey City	2.48	2.48	2.12
Boston	*2.75*	2.85	2.50
Chicago	2.05	2.05	1.97
Pittsburgh	2.14	2.14	2.02
Cleveland	2.36	2.36	2.26
Detroit	2.33	2.33	2.17
Indianapolis	2.26	2.26	2.21
Toledo	2.33	2.33	2.20
Milwaukee	2.22	2.22	2.18
Duluth	2.04	2.04	1.95
Peoria	2.26	2.26	2.13
Cedar Rapids	2.33	2.33	2.26
Davenport	2.28	2.28	2.21
St. Louis	2.35	2.35	2.20
San Francisco	2.71	2.71	2.84
New Orleans	3.30	3.30	3.20
Minneapolis	2.29	2.29	2.24
Denver	2.85	2.85	2.90
Seattle	2.90	2.90	2.94
Dallas	2.25	2.25	2.40
Atlanta	*2.50*	2.54	2.69
Cincinnati	2.39	2.39	2.35
Los Angeles	....	....	3.31
Baltimore	2.51	....	2.50
Birmingham	2.40	2.40	2.27
Kansas City	*2.35*	2.45	2.40
Montreal	*2.15*	2.40	2.65
Philadelphia	*2.41*	2.51	2.21
St. Paul	2.29	2.29	2.24

NOTE—Bags 10c. each, 40c. per bbl.;

Current mill-prices per barrel in carload lots, without bags, to contractors:

Buffington, Ind.	$1.80	La Salle, Ill.	$2.05
Universal, Pa.	1.90	Hudson, N. Y.	2.20
Steelton, Minn.	1.85	Leeds, Ala.	2.20
Fordwick, Va.	2.20	Hannibal, Mo.	2.10
Mitchell, Ind.	2.05	Lehigh Valley District	2.10
Iola, Kan.	2.10	Wyandotte, Mich.	2.05
Mason City, Ia.	2.05	Alpena, Mich.	1.85

TRIANGLE MESH—Price per 100 sq.ft in carload lots:

PLAIN 4-INCH BY 4-INCH MESH

Style Number	Weight in Pounds per 100 sq.ft.	Pittsburgh, Mill	Warehouse: New York	Chicago	St. Louis	Dallas	San Francisco
032	22	$0 85	$1 13	$0 92	$0.94	$1 172	$1 03
049	28	1 08	1 44	1 18	1.20	1 488	1 34
068	35	1 31	1 76	1 43	1.46	1 835	1 64
093	45	1 69	2 26	1 84	1.88	2 345	2.10
126	57	2 08	2 73	2.27	2.33	2.917	2.60
153	68	2.48	3.25	2.71	2.77	3.468	.....
180	78	2.85	3.69	3.12	3.19	4.08	.....
245	103	3.76	5.05	4.11	4.20	5 253	.....
287	119	4 34	5.90	4.74	4.85	6.079	5.43
336	138	5 04	6.80	5.51	5.63	7.458	.....
395	160	5.84	7.81	6.38	6.53	8.16	.....

PAVING

036P	17	$0.65	$0.84	$0.71	$0.72	$0.897	.....
053P	24	.91	1.14	.99	1.01	1 284	.....
072P	31	1.15	1.52	1.26	1.28	1 601	.....
097P	40	1.48	2.00	1.62	1.65	2.06	.....
049R	24	.91	....	.99	1.01	1.264	.....
067R	31	1.15	....	1.26	1.28	1 601	.....
089R	40	1.48	....	1.62	1.65	2 06	.....

(Chicago quotations merely nominal)

In rolls 16-, 20-, 24-, 28-, 32-, 36-, 40-, 44-, 48-, 52-, and 56-in. wide and in 150-, 200- and 300-ft. lengths Galvanized is about 15% higher. Size of roll carried in New York warehouses, 48 in. wide x 150 ft. long, or 600 sq. ft.

EXPANDED METAL LATH—Prices in carload lots per 100 yd. for painted are as follows:

Gage	Weight	*New York	Chicago	St. Louis	San Francisco	Dallas
27Dia.	2.3	$22 00	$20 39	$20 72	$20.78	$25 50
26 "	2.5	22 00	21 93	22 39	21.43	27 58
25 "	3.0	22 00	24 45	24 93	.....	30 71
24 "	3.4	24 00	26 33	27 10	24.28	33 16
22 "	4.33	27.00	31 06	32 27	.....	35 10

* Price to contractors at warehouse or delivered on job in Manhattan, Bronx or Brooklyn.

BARS, CONCRETE REINFORCING—Current quotations per 100 lb.:

ROLLED FROM BILLETS

Inches	Pittsburgh Mill	Birmingham Mill	Warehouse, Uncut: New York	Chicago	St. Louis	Dallas	San Francisco
¼ and larger....	$2.00	$2 35	$3 19	$2 92½	2 90	$3.15	$3 30
⅜	2 05	2 45	3 24	2 97½	2 95	3 20	3 35
½	2 10	2 55	3 29	3 02½	3 00	3.25	3 40
⅝	2 25	2 60	3 34	3 17½	3 15	3.40	3 55
¾	2.50	2.65	3.69	3.42½	3 30	3.65	3.80

Includes 15c charge for cutting to lengths of 2 ft. and over.
Twisted bars cut to length take extra of 27½c. per 100 lb.

ROLLED FROM RAILS

	Chicago	St. Louis	Dallas		Chicago	St. Louis	Dallas
¼ and larger	$2 10	$2.60	$3.50	½	$2.35	$2 85	$3 95
⅜ in	2 15	2.65	3.75	¾	2.60	3.00	4 20
½	2 20	2.70	3.80	.....	.....	.....	....

BRICK—Contractors price per 1,000 in cargo or carload lots is as follows:

	Common: Feb. 1	One Month Ago	One Year Ago	Paving Block: 3-inch*	4-inch*
New York (del.).....	$23.50	$23.50	$20.40	$42.00†	$50 00†
New York (at dock)...	20.00	20.00	14@15	.....	.....
Chicago.....	11 00	11 00	11.00	34.00	42 00
St. Louis, salmon.....	16 00	15.00	16 00	36.50	41.00
Denver, salmon.....	12.00	12.00	14.00	.....	.....
Dallas.....	9.85	10.90	11.00	no market	
San Francisco.....	15.50	15.50	15.50	.....	.....
Los Angeles (del.).....	.....	.....	15.50	(not used)	
Boston (del.).....	20.00	20.00	17.00	72.00	72 00
Minneapolis (del.).....	17@19	18@19	15.00	.....	43.00
Kansas City.....	14.50	14.50	14.50	.....	.....
Seattle.....	13.00	14 00	14 00	50 00	.....
Cincinnati.....	18 00	17.00	17.00	42 00	42.00
Montreal.....	16.00	16.00	16.00	100.00‡	68.00
Detroit (del.).....	16.50@17.00	16.50@17	16 50@17	36.50	39.50@41
Baltimore (del.).....	18.00	....	20.00	40.00	45.00
Atlanta.....	10.00	10.00	9.00	39.00	.....
New Orleans.....	15.75	15.75	12.50	.....	.....
Birmingham.....	12.50	12.50	10.50	.....	.....
Philadelphia.....	20@28	20@28	16.00	40.00	48.00
Pittsburgh (del.).....	16.00	16.00	.....	.....	.....
Cleveland.....	16.00	16.00	.....	.....	.....

*For paving blocks 3½x8½x3 and 3½x8½x4 respectively. † F.o.b. ‡Imported.

HOLLOW TILE—Price per block in carload lots to contractor for hollow building tile.

	New York: Feb. 1 on Trucks*	New York: One Year Ago	Chicago	Philadelphia	St. Louis	San Francisco	Perth Amboy N. J., Factory*
4x12x12..	$0.123	$0.1112	$0.0674	$0.12	$0 088	$0.108	.....
6x12x12...	.1844	.1667	.0926	.....	.110	.156	.....
8x12x12...	.2305	.2084	.1263	.1875	.150	.244	$0.2147
10x12x12...	.....	.....	.1621	.....	.18	.....	.2653
12x12x12...	.....	.....	.1853	.....	.22	.....	.3448

* 5 per. off for cash.

	4x12x12	8x12x12	12x12x12
Boston.....	$0.10	$0.19	.....
Minneapolis (f.o.b. cars).....	0 736	.12125	$0.214
Minneapolis (delivered).....	0836	.1369	.239
Cincinnati.....	.0859	.1611	....
Kansas City.....	.083	.105	....
Denver.....	.065	.123	.188
Seattle (delivered).....	.11	.25	.36
Los Angeles factory.....	....	....	....
New Orleans.....	.12	.23	.36
Detroit (delivered).....	.09	.175	.26
Montreal.....	.105	.225	.30
Baltimore.....	.10	.215	.....
Atlanta.....	.0859	.1615	.....
Dallas.....	.115	....	.....
Birmingham.....	.11	.18	.....
Pittsburgh (delivered).....	.068	.128	.179
Cleveland.....	.08	.164	.....

San Francisco, Philadelphia, Atlanta, New York and Chicago quote on hollow partition tile.

STRUCTURAL MATERIAL—Following are base prices f. o. b. mill, Pittsburg and Birmingham together with quotations per 100 lb. from warehouses at place named:

	Pittsburgh, Mill	Birmingham Mill	Warehouse: New York	Dallas	St. Louis	Chicago	San Francisco
Beams, 3 to 15 in.	$2.10	$2 40	$3.29	$4 40	$3.00	$3 02½	$3.25
Channel, 3 to 15 in. ...	2.10	2.40	3 29	4 40	3.00	3.02½	3.25
Angles, 3 to 6 in., ¼ in. thick.....	2.10	2.40	3 29	4 40	3.00	3.02½	3.25
Tees, 3 in. and larger...	2.10	2.40	3 29	4.40	3.00	3.02½	3.25
Plates, ¼ in. thick and heavier.....	2.10	2.40	3.29	4.50	3.00	3.02½	3.35

RIVETS—The following quotations are per 100 lb.:

STRUCTURAL

	Pittsburgh, Mill	Warehouse: New York Feb 1	New York One Yr. Ago	Chicago	St. Louis	San Francisco	Dallas
½ in. and larger	$3.00	$3 85	$3.50	$3.75	$3 85	$4.75	$5.25

CONE HEAD BOILER

½ in. and larger.	$3.10	3.95	3 60	3 85	3.95	4.85	5.40
⅝ and ¾.....	3.25	4.11	3 76	4 00	4 10	5.00	5.55
⅞ and 1⅛.....	3.50	4.35	4.00	4.25	4 35	5.25	5.35

Lengths shorter than 1 in. take an extra of 50c. Lengths between 1 in. and 2 in. take an extra of 25c.

NAILS—The following quotations are per keg from warehouse:

	Pittsburgh, Mill	Chicago	San Francisco	Dallas	St. Louis	Montreal
Wire.....	$2.70@2.80	$3 45	$4 00	$4 40	$3.19	$4.95
Cut.....	3.20@3.25	5 50	5.65	6.90	3.29	5.00

PREPARED ROOFINGS—Slate-surfaced roofing (red and green) in rolls of 108 sq.ft. costs $1.95 per roll in carload lots and $2.20 for smaller quantities f.o.b. Philadelphia.

Single shingles, red and green slate finish, cost $5.50 per square (sufficient to cover 100 sq.ft.) in carloads; $5.75 in smaller quantities, f.o.b. Philadelphia. Strip shingles (4 in 1) f.o.b. Philadelphia. l.c.l., $5.90.

ROOFING MATERIALS—Prices f.o.b. New York, in less than carload lots:

Tar felt (14 lb. per square of 100 sq.ft.) per ton.....	$73.50
Tar pitch (in 400-lb. bbl.), per 100 lb.....	1.62½
Asphalt roofing (in barrels), per ton, f.o.b. plant*.....	37.00
Asphalt felt (light), per ton, f.o.b. plant*.....	67.50
Asphalt felt (heavy), per ton, f.o.b. plant*.....	67.50

* Delivered in Metropolitan Dist., $3.00 additional.

SHEETS—Quotations are per 100 lb. in various cities from warehouse also the base quotations from mill:

Blue Annealed	Pittsburgh, Large Mill Lots	St. Louis	Chicago	San Francisco	New York
No. 10.....	$2.50@2.75	4.10	$4.00	$4.35	$4.19
No. 12.....	2.60@2.85	4.15	4.05	4.40	4.24
No. 14.....	2.70@2.95	4.20	4.10	4.45	4.29
No. 16.....	2.90@3.15	4.30	4.20	4.55	4.39
Black					
*Nos. 18 and 20.....	3.20@3.35	4.65	4.70	5.70	4.70
*Nos. 22 and 24.....	3.25@3.40	4.70	4.70	5.75	4.75
*No. 26.....	3.30@3.45	4.75	4.75	5.80	4.80
*No. 28.....	3.35@3.50	4.80	4.85	5.90	4.90
Galvanized					
No. 10.....	3.35@3.50	4.85	4.85	....	4.90
No. 12.....	3.45@3.60	4.95	4.95	5.85	5.00
No. 14.....	3.45@3.60	5.00	4.95	5.85	5.00
Nos. 17 to 21.....	3.75@3.90	5.10	....	6.15	5.30
Nos. 22 and 24.....	3.90@4.05	5.40	5.40	6.30	5.45
*Nos. 25 and 26.....	4.05@4.20	5.55	5.55	6.45	5.60
*No. 28.....	4.35@4.50	5.85	5.90	6.75	5.90

*For painted corrugated sheets add 30c. per 1,000 lb. for 5 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 15c., all gages.

LINSEED OIL—These prices are per gallon:

	New York: Feb. 1	New York: One Year Ago	Chicago: Feb. 1	Chicago: One Year Ago
Raw in barrel (5 bbl. lots).....	$0.93	$0.77	$0.98	$0.80

WHITE AND RED LEAD—Base price in cents per pound:

	Red				White	
	Feb. 1		1 Year Ago		Feb. 1	Yr. Ago
	Dry	In Oil	Dry	In Oil	Dry or In Oil	Dry or In Oil
100-lb. keg	14.25	15.75	12.25	13.75	14.25	12.25
25 and 50-lb. kegs.	14.50	16.00	12.50	14.00	14.50	12.50
12½-lb. keg	14.75	16.25	12.75	14.25	14.75	12.75
5-lb. cans	17.25	18.75	15.25	16.75	17.25	15.25
1-lb. cans	19.25	20.75	17.25	18.75	19.25	17.25

LUMBER

Prices wholesale, per M. ft. b.m., to dealers in carload lots, f.o.b.

San Francisco—Prices of rough Douglas fir No. 1 common, in carload lots to dealers at yards. To contractors, $2 per M ft. additional.

	6–8 and 12 Ft.	10–16–18 and 20 Ft.	22 and 24 Ft.	25 to 32 Ft.
2x3 and 4	$35.00	$36.00	$37.00	$40.00
3x6 and 8	35.00	36.00	37.00	40.00
4x4-6 and 8	35.00	36.00	37.00	40.00
3x10 and 12	35.00	36.00	37.00	40.00
3x14	37.00	37.00	39.00	41.00
4x10 and 12	35.00	36.00	37.00	40.00
4x14	37.00	37.00	39.00	41.00

	24 Ft. and Under	25 to 32 Ft.	33 to 40 Ft
6x10	$37.00	$39.00	$41.00
6x14	37.00	39.00	41.00
8x10	37.00	39.00	41.00
8x14	37.00	39.00	41.00

New York and Chicago—Wholesale prices to dealers of long leaf yellow pine.

	New York*		Chicago	
	20 Ft. and Under	22–24 Ft.	20 Ft. and Under	22–24 Ft.
3x 4 to 8x8	$49.00	$50.00	$50.50	$52.50
3x10 to 10x10	52.00	53.00	53.50	55.50
3x12 to 12x12	56.00	57.00	56.50	58.50
3x14 to 14x14	62.00	63.00	61.50	63.50
3x16 to 16x16	69.00	70.00	66.50	68.50
3x18 to 18x18	82.00	83.00	77.50	79.50
4x20 to 20x20	92.00	93.00	89.50	91.50

*Wholesale price to dealers; to contractors, delivered from lighters or cars to job, $5 additional. Short leaf pine up to 14 x 14 costs $15 per M. less.

Over 24 ft.—Add $1 for each additional 2 ft. in length up to 30 ft. for sizes 12 x 12 and under, for sizes over 12 x 12 add $2, for merchantable add $2 to sizes 10 x 10 and under. For pine add $2 to the price of merchantable for all sizes.

Other Cities

	8 x 8-In. x 20 Ft. and Under				12 x 12-In. 20 Ft. and Under	
	P.	Fir	Hemlock	Spruce	P.	Fir
Boston	$2.00	.....	.....	$60.00	$78.00	.....
Seattle	.....	$28.00	.....	.....	.....	$28.00
New Orleans	35.00	.....	.....	35.00	40.00	.....
Baltimore	35.00	52.00	$52.00	60.00	50.00	53.00
Cincinnati	*40.00*	48.00	48.50	.....	55.00	50.00
Montreal	50.00	50.00	40.00	38.00	78.00	90.00
Los Angeles	.....	.....	.....	.....	.....	.....
Denver	.....	41.00	44.00	41.00	.....	41.00
Minneapolis	45.50	42.75	41.00	.....	48.00	44.75
Atlanta	*55.00*	.....	.....	.....	*85.00*	.....
Dallas	45.00	.....	.....	.....	48.00	.....
Kansas City	*58.50*	47.00	47.00	49.50	52.75	.....
Birmingham	32.00	.....	.....	.....	40.00	.....
Philadelphia	45.00	39.00	40.00	44.00	55.00	39.00
Detroit	46.75	48.25	.....	.....	55.75	48.25
St. Louis	44.50	.....	.....	.....	49.50	.....

	1-In. Rough, 10 In. x 16 Ft. and Under			2-In. T. and Gr. 10 In. x 16 Ft.	
	P.	Fir	Hemlock	P.	Fir
Boston	$50.00	.....	.....	$55.00	.....
Seattle	.....	$24.00	.....	.....	$26.00
New Orleans, at mill	80.00	.....	.....	39.00	.....
Baltimore	65.00	43.00	$43.00	36.00	55.00
Cincinnati	75.00	77.50	68.50	*56.00*	*80.00*
Montreal	60.00	50.00	37.00	45.00	45.00
Los Angeles	.....	.....	.....	.....	.....
Denver	.....	36.25	36.25	.....	36.25
Minneapolis	48.50	41.25	38.50	43.75	40.25
Atlanta	*17.00*	.....	.....	*27.00*	.....
Dallas	45.00	36.00	.....	48.60	.....
Kansas City	77.00	*38.00*	*38.00*	74.00	40.00
Birmingham	28.00	.....	.....	32.00	.....
Philadelphia	34.50	41.00	40.00	55.00	39.00
Detroit	*48.00*	40.00	.....	*46.50*	*41.50*
St. Louis	50.00	.....	.....	40.00	.....

Montreal—Up to 32 ft.; over which, $3.00 per M. ft. increase up to 30 ft.

Birmingham—Quotes carload lots, f.o.b. sidings. $1.50 additional per M. ft. to contractors.

Boston and Cincinnati—Prices to contractors in carload lots, f.o.b.

Denver—Quotes dealers prices to contractors on large projects.

St. Louis—Wholesale price to contractors, $7@$11 per M. ft. additional.

Seattle—Price to contractors, delivered.

Dallas—Wholesale to contractors, $10 per M. ft. additional.

FREIGHT RATES

On finished steel products in the Pittsburgh district, including plates, structural shapes, merchant steel, bars, pipe fittings, plain and galvanized wire nails, rivets, spikes, bolts, flat sheets (except planished), chains, etc., the following freight rates are effective in cents per 100 lb., in carloads of 36,000 lb.:

Baltimore	$0.315	Detroit	$0.295
Birmingham	.69	Kansas City	.735
Boston	.365	New Orleans	.515
Buffalo	.265	New York	.34
Chicago	.34	Pacific Coast (all rail)	1.50†
Cincinnati	.295	Philadelphia	.325
Cleveland	.215	St. Louis	.43
Denver	1.275*	St. Paul	.595

* Minimum carload, 40,000 lb.

† Minimum carload, 50,000 lb., structural steel only; 80,000 lb. for other iron or steel products.

CONTRACTORS' SUPPLIES

STEEL SHEETPILING—The following price is base per 100 lb. f. o. b. Pittsburgh, with a comparison of a month and a year ago:

Feb. 1	One Month Ago	One Year Ago
$2@2.05	$2@2.05	$1.55@1.60

WIRE ROPE—Discounts from list price on regular grades of bright and galvanized are as follows:

	Eastern Territory New York and East of Missouri River
Hercules red strand, all constructions	25%
Patent flattened strand, special and cast steel	25%
Patent flattened strand, iron rope	10%
Plow steel round strand rope	40%
Special steel round strand rope	35%
Cast steel round strand rope	27½%
Round strand iron and iron tiller	10%
Galvanized steel rigging and guy rope	12½%
Galvanized iron rigging and guy rope	+7½%

California, Oregon, Nevada and Washington Discount 5 points less than discount for Eastern territory.

Wyoming, New Mexico and Colorado: Discount 5 points less than discount for Eastern territory.

Arizona: Discount 10 points less than discount for Eastern territory.

Montana, Idaho and Utah: Discount 10 points less than discount for Eastern territory.

North Dakota, Nebraska, Kansas, Oklahoma and Texas: Discount 5 points less than discount for Eastern territory.

MANILA ROPE—For rope smaller than ½-in. the price is ½ to 2c. extra; while for quantities amounting to less than 600 ft., there is an extra charge of 1c. The number of feet per pound for the various sizes is as follows: ½-in., 8 ft.; ⅝-in., 6; ¾-in., 4½; 1-in., 3½; 1¼-in., 2 ft. 10 in.; 1½-in., 2 ft. 4 in. Following is price per pound for ½-in. and larger, in 1200-ft. coils:

Boston	*$0.16½*	New Orleans	$0.18
New York	.17	Los Angeles	.....
Chicago	.18	Seattle	.18
Minneapolis	.20½	St. Louis	.17½
San Francisco	.16	Montreal	.30
Atlanta	*.18½*	Detroit	.19
Denver	.20	Baltimore	.18
Cincinnati	.20	Kansas City	.19½
Dallas	*.18?*	Birmingham	.20½
Philadelphia	.18		

EXPLOSIVES—Price per pound of dynamite in small lots:

	Gelatin 40%	Gelatin 60%
New York	$0.27	$0.30
Boston	.23	.25
Kansas City	.2225	.2525
Seattle	.165	.195
Chicago	.22	.25
Minneapolis	.189	.2094
St. Louis	.22	.25
Denver	.2025	.2325
Dallas	.29	.375
Los Angeles	.....	.....
Atlanta	.23	.26
Baltimore	.215	.225
Cincinnati	.22	.25
Montreal	.195	.235
Birmingham, *delivered*	.20½	.22
New Orleans	.235	.265
San Francisco	.1625	.1925
Philadelphia	.25	.28

PILES—Prices per lineal foot, pine piles with bark on, f.o.b. New York.

Diameters	Points	Length	Barge	Rail
12 in. at butt	6 in.	30 to 50 ft.	$0.13	$0.17½
12 in.—2 ft. from butt	6 in.	50 to 59 ft.	0.17½	0.22
12 in.—2 ft. from butt	6 in.	60 to 69 ft.	0.19½	0.24
14 in.—2 ft. from butt	6 in.	50 to 69 ft.	0.23	0.32
14 in.—2 ft. from butt	6 in.	70 to 79 ft.	0.25	0.34
14 in.—2 ft. from butt	5 in.	80 to 89 ft.	0.32	0.38

SCRAP—The prices following are per gross ton paid to dealers and producers f.o.b. New York. In Chicago and St. Louis the quotations are per net ton and cover delivery at the buyer's works, including freight transfer charges.

	New York	Chicago	St. Louis
No. 1 railroad wrought	$16.50	$11.50	$16.00
Stove plate	14.00	12.00	16.50
No. 1 machinery cast	18.00	16.50	20.00
Machine shop turnings	10.00	4.00	*9.50*
Cast borings	12@14	5.50	11.00
Railroad malleable cast	15.00	12.50	18.50
Re-rolling rails	17.00	13.00	20.00
Relaying rails	28.50	30.00	27@32
Heavy melting steel	16.00	.....	.....

SHIP SPIKES—Current prices per 100 lb.:

In.	San Francisco Galv.	San Francisco Black	Seattle Black
½	$7.50	$8.00	$8.00
⅝	7.05	5.55	7.75
¾	6.50	5.40	7.70

Pittsburgh base in lots of 200 kegs or more, $3.50.

H
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Devoted

Drive